75th Year of editorial service to power progress

Power

JANUARY 1957·50¢

A McGRAW-HILL PUBLICATION

Radioactive isotopes: Your new maintenance tool ► 111

- Eddystone plant — new high in superpressures 102
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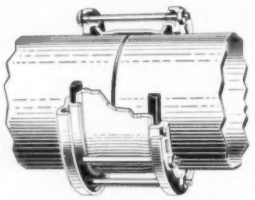
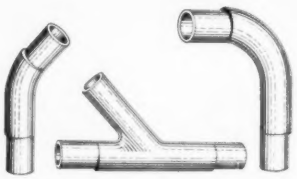
MATERIALS HANDLING SYSTEMS PERFORM BETTER, LAST LONGER WITH A-S-H PIPE AND FITTINGS

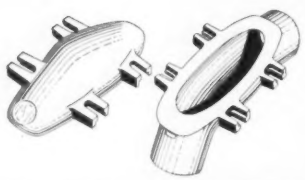
A-S-H pipe and fittings improve the operation of any materials handling system. They are specially designed and constructed to provide leak-proof service, utmost resistance to abrasion, uniform distribution of wear, long life, low maintenance and ease of installation and replacement.



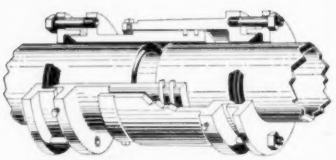
ASHCOLITE PIPE—Chrome-iron alloy, cast by the sand-spun method, gives Ashcolite a tough, dense, close-grained structure making it highly resistant to abrasion. Standard sleeve couplings permit quick pipe connection, make it easy to rotate the pipe for uniform distribution of wear. Ashcolite pipe is furnished in sizes from 4 to 12 in. I.D. and lengths up to 16 ft. Data Sheet Wa gives full details.



ONE-PIECE, WEAR-BACK FITTINGS of Ashcolite chrome-iron alloy reduce abrasive wear. Wall thickness is increased on the outer radius where most wear occurs. Elbows have turn angles of 90° and 45° with long turn radii to reduce friction loss. 90° and 45° laterals are also available. Write for Data Sheet Wc.



REVERSIBLE, WEAR-BACK IMPACT FITTINGS are designed for long wear and low friction loss in pneumatic handling systems. They feature a separate, Ni-hard alloy wear-back bolted to the Ashcolite body for easy replacement or reversing. Reversing the wear-back in service distributes the wear and prolongs its life. Fittings are available in 45° and 90° elbows and 45° laterals. Send for Data Sheet Wb.



A-S-H EXPANSION JOINTS provide long-wearing, air-tight connections for long pipe lines in pneumatic handling systems—accommodate axial expansions up to 1½ in. per joint. Expansion joint sleeves fit over pipe ends, minimizing wear by removing entire assembly from flow of materials. Piston rings assure airtight seal. A-S-H joints are made for Ashcolite pipe and Classes C and D cast iron pipe. Ask for Data Sheet Wd.

Write for these A-S-H Data Sheets

The **Allen-Sherman-Hoff** Company

259 E. Lancaster Ave., Wynnewood, Pa.

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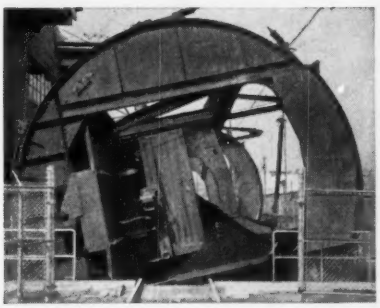
MATERIALS HANDLING SYSTEMS

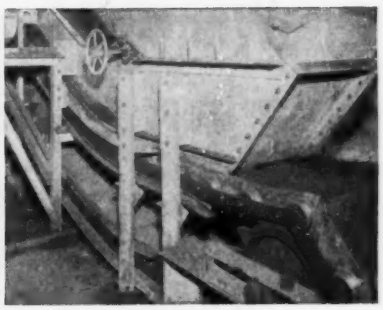
hydrojet *hydraulic* / **hydrovac** *pneumatic*

For all sizes of power plants--



ROTARY DUMPERS unload gondola cars in 90 seconds or less (including return to upright position). Handle all types of open-top cars up to 90-ton capacity.

LINK-BELT CAR SHAKER is easier on cars, thanks to exclusive low-frequency vibration. Noise level is lower. Positive action cleans hopper-bottom cars fast.

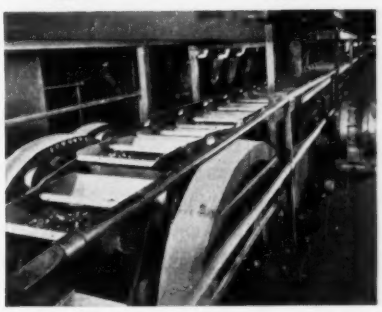


APRON FEEDERS move coal horizontally or on inclines up to 25° from hoppers or bins in continuous, uniform flow. Rugged overlapping pans resist impact.

LINK-BELT equipment and engineering...

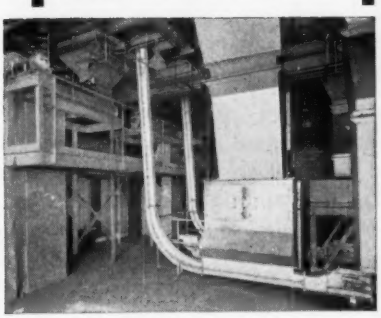
BELT CONVEYORS handle large tonnages at low cost—stock out, reclaim, distribute. Link-Belt also builds all types of idlers, terminal machinery, trippers, etc.

BUCKET ELEVATORS offer flexible, low-cost handling. Link-Belt elevator shown discharges to silo and also handles coal to and from reserve ground storage.

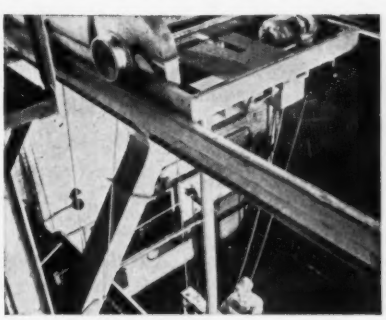


PECK CARRIERS, used in many coal handling systems for the last 60 years, elevate and convey coal in a continuous flow without the need for transfers.

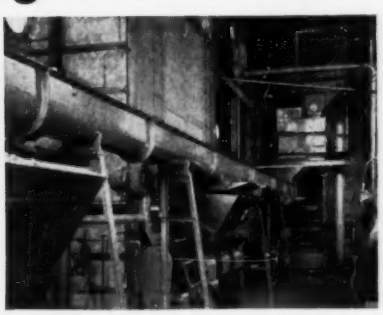
spell lowest per-ton handling costs



BULK-FLO combines functions of conveyor, elevator and feeder in a single unit of high capacity. Above, coal is delivered to crusher for continuous sampling.



WEIGH LARRIES automatically weigh and record amount of coal delivered to each stoker or bunker. Link-Belt offers motor or hand-propelled types in all sizes.



SCREW CONVEYORS provide economical distribution of coal to stoker hoppers. Link-Belt can supply all components—screws, troughs, hangers, drives, etc.

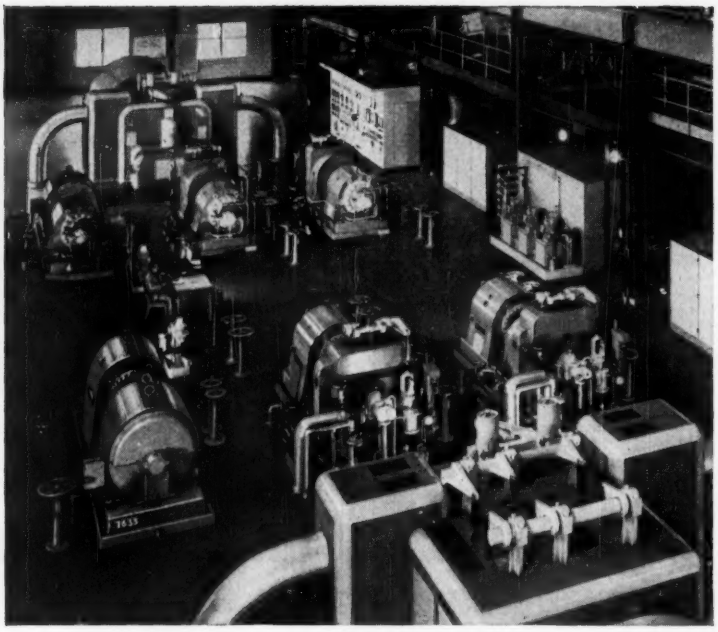
You'll be interested in Book 2410. Its 44 pages of photographs and drawings include many outstanding Link-Belt coal handling systems, large and small. Your nearest Link-Belt office has your copy.

LINK-BELT

COAL HANDLING EQUIPMENT

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 14 227

What makes a barrel-type boiler feed pump *stay in service?*



Here are some of the design features that assure dependability

Today's modern multi-stage centrifugal pumps for boiler feed service are the result of years of research and design. To provide efficient service *plus* dependability, De Laval has incorporated these important features in its barrel-type pump.

Double Volute Diaphragms

Double volute diaphragms provide for radial hydraulic balance and assure a continuous rising head characteristic from the design point to shut-off. *RESULT—Higher efficiencies are maintained over a wider range of operation than are generally obtained with other forms of velocity pressure conversion.*

Individual Diaphragm Bolting

Elimination of rabbet fits and gaskets permits straight metal-to-metal contact of adjacent lapped faces of the diaphragms which are individually bolted together to maintain tight joints and ease of assembly. *RESULT—Positive assurance against inner case leakage, complete elimination of misalignment causes and a minimum of distortion from sudden temperature changes.*

Positive Sealing Between Suction and Discharge Chamber

Inner assembly is held at the inner high pressure joint at the suction end of the barrel, against a flexitallic gasket, with through bolts. The joint between the suction and discharge chambers is made tight during assembly—remains tight whether pump is operating or idle. *RESULT—No possibility of leakage or gasket loosening due to changes of force on the inner joint.*

Bare Shaft

Bare shaft construction with split ring-shrink fit method of impeller mounting permits a scalloped shaft design and eliminates the need for spacer sleeves between impellers. *RESULT—Better hydraulic conditions at the eye of the impeller and elimination of spacer sleeves—the greatest cause of shaft warpage.*

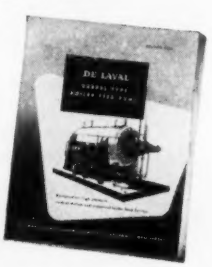
Wearing Rings

Diaphragms and impellers have renewable wearing rings. Impeller rings are threaded on the impeller hubs against rotation, and diaphragm rings are held by a breech lock fit in the diaphragms. *RESULT—Construction permits renewal of original clearances without major part renewal or modification. Labyrinth type diaphragm ring results in minimum leakage over a longer period of time than with close clearance flat rings.*

IMO Oil Pump

A De Laval IMO pump designed for high speed operation is direct-connected to the outboard end of the barrel pump shaft, and is sized to lubricate both pump and driver bearings. *RESULT—Quiet, pulsation-free, positive displacement IMO pumps, assures positive lubrication and eliminates the need of extra shaft length and mechanical complications required by gear drive lube oil pumps.*

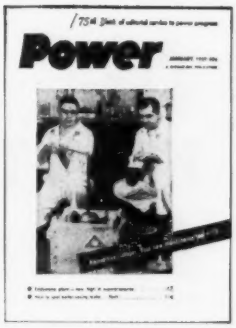
BULLETIN CONTAINS HELPFUL DATA



This De Laval bulletin on the barrel-type boiler feed pump covers all major design points . . . has cross-section cut-away illustration for easy reference. Write on your business letterhead for your copy of Bulletin 1506 to De Laval Steam Turbine Company, **815** Nottingham Way, Trenton 2 New Jersey.

Power

JANUARY 1957 • VOLUME 101 NUMBER 1



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COVER PHOTOS that really tell a story are hard to come by. Assoc Ed Steve Elonka wanted an on-the-job shot to pinpoint key steps necessary to bring radioactive isotopes into a plant (article, p 111).

Oak Ridge offered to setup the photo. First shots, showing a lab assistant removing the 'hot' stuff, fell short of our needs. Steve made a sketch of his wants, gave it to Gordon Molesworth, author of article.

Gordon, a 9-year man in nuclear energy, established Molesworth Associates in '54 to provide a public relations outlet for the nuclear field. He set the wheels in motion, came up with this month's cover.

Next month . . .

Electrical Code changes are tough to find. Sandwiched into the *1956 National Electrical Code* (latest edition) are new regulations governing differential relaying, fuses in multiple, grounding of lightning arrestors. February article outlines each change.

"Marmy's Dancing Pumps" in upcoming issue pose a tricky roller-bearing problem. And, in characteristic fashion, Marmy solves the headache—by phone, from some 6500 miles away.

Oil-lubricated motors, when in trouble, generally call for dragging the oil on carpet. In next issue Sim Jester probes the reasons for overheating bearings, color change, oil dripping.

. . . and a future month

Puerto Rico's *Operation Bootstrap* is attracting much attention and a parcel of new industries. March issue carries first-hand data on power changes taking place to meet this industrial boom.

JANUARY 1957 POWER Vol. 101—No. 1

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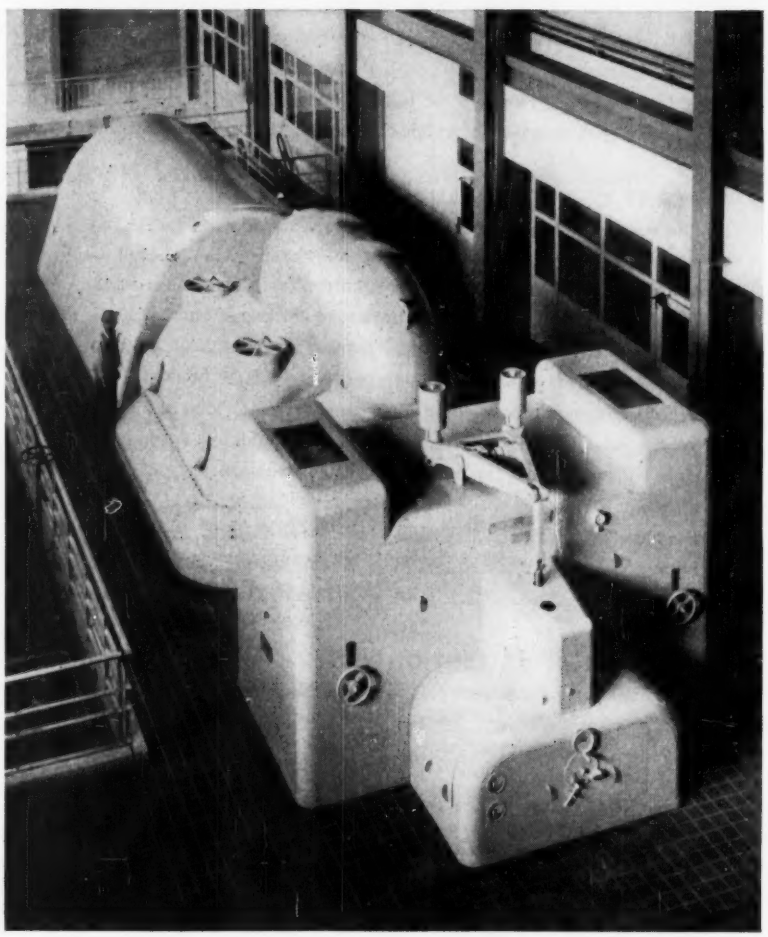

TEXACO

TEXACO Regal Oils R&O

FOR ALL TURBINES

TUNE IN . . . METROPOLITAN OPERA RADIO BROADCASTS EVERY SATURDAY AFTERNOON

speaking of **Power**

Hicks to Marks: passing on the editorial mantle

Ty Hicks takes a step up the ladder; Bob Marks joins *Power* staff

Not until the December '56 report on corrosion was over the hump did Special Projects Editor Ty Hicks swing away from his desk and set sights on new duties as Editor, Engineering Books, for McGraw-Hill Book Co. After 7 years as a top-draw POWER staffer, Ty has reached another rung on the ladder. Buttoning up loose ends in characteristic Hicks' fashion, Ty cleared the top of his desk into an attache case, shook hands all around and boarded an elevator to his new 20th floor office in the same McGraw-Hill Building.

Ty, as Special Projects Editor, guided many reports through to a successful conclusion. In each case it meant working closely with individual editors writing the report. *Motors, Nuclear Energy Today, Industrial Lighting, Corrosion* are a few of the reports Ty kept an eye on.

Ty came to POWER in March 1950 after building up 12 years of heavy experience by running the gamut from steam- and diesel-engine operation aboard merchant ships to design engineering for Lockwood Greene. A Cooper Union night-school grad in mechanical engineering, Ty mastered the art of spending every waking hour gainfully. He authored several books: latest, *Pump Selection and Application*, will be published this month. Tucked between a full-time editorial job and off-time book authoring, Ty finds time to serve as instructor in mechanical engineering at Cooper Union's evening school, associate on the executive committee of ASME's Oil and Gas Power Division—all this plus editing the Division's *Proceedings*. In brief, Hicks is a hard-working man, bound to make a sizable contribution in his new post.

Bob Marks, POWER's new Assistant Editor, is right now sizing up his position while digging into many of the technical areas formerly held down by Hicks. With an MIT degree, plus 9-years engineering experience (including eight with Permutit Co in water treatment) Bob is well qualified to step into our editorial family. Over the years Marks has seen several of his articles published in POWER. Early signs point to his becoming an editorial heavyweight.

The Power Show, held last November in New York's brand new Coliseum, pulled engineers from all branches of the power business to see first-hand what was new—equipment-wise. And many stopped at POWER's booth to vote for which of the 11 special-report reprints they would like to receive free should the wheel of chance rule in their favor. Incidentally, of the 11 reports (plus the Marmaduke Story) the one receiving most requests was *Nuclear Energy Today* closely followed by *Pumps*. The bound volume of special reports was won by W F Ruffner, Washington, D.C. It will prove a mighty handy reference for him.

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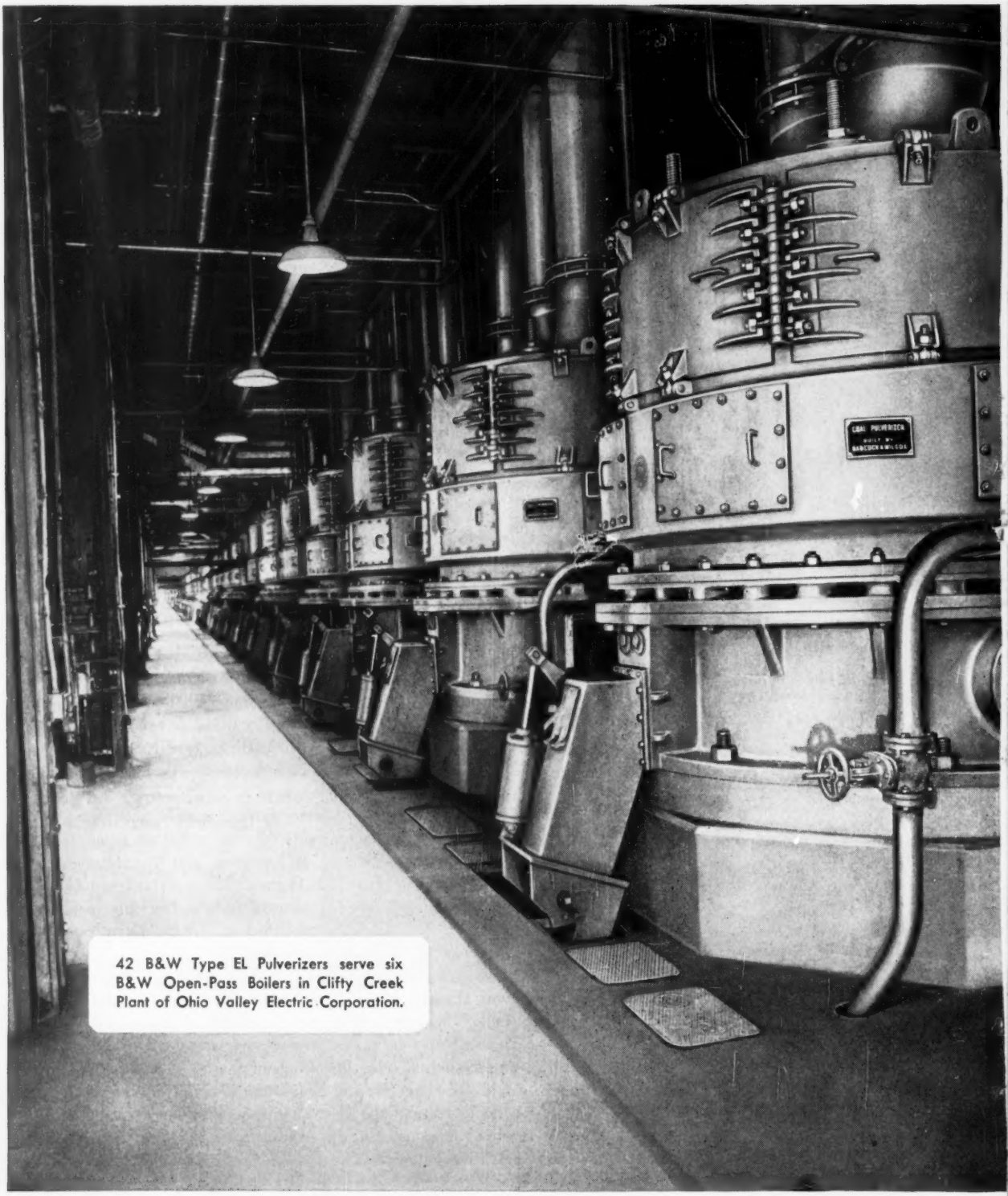

42 B&W Type EL Pulverizers serve six B&W Open-Pass Boilers in Clifty Creek Plant of Ohio Valley Electric Corporation.

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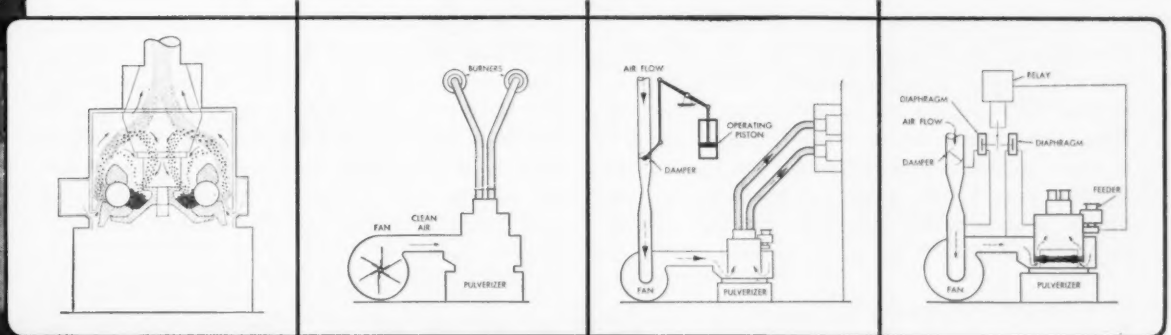
Continuous High Fineness Over Entire Service Life: Efficient combustion requires high fineness at all times. The high circulating load of the B&W Pulverizer permits efficient and dependable classification of product, so that only material of proper fineness leaves the unit. In addition, its slow-speed, spring-loaded ball bearing grinding elements maintain proper grinding contact throughout their service life.

Handles Wide Variety of Low Grade and Wet Coal: Regardless of the coal's grade or whether it's dry or soaking wet, the B&W Pulverizer's unique and exclusive recirculation of fuel through heated air assures efficient grinding . . . eliminates shutdown, capacity loss, or special attention from operators.

Simplicity of Arrangement and Reduced Maintenance: Accessibility for all normal maintenance makes it simple, quick, safe and low-cost. Adjustments are easily made while the unit is in operation. Using only clean primary air supplied under pressure, fan maintenance is substantially reduced and fuel piping is greatly simplified. Also, with the pulverizer acting as its own distributor, no special distributing devices are needed. Grinding elements are of special alloy material. They last two years or more on eastern coals and at least a year on midwestern coals.

Adaptable to All Types of Automatic Controls: Because it features "one point contact with the boiler," operation of the B&W Pulverizer is simple. The boiler's automatic combustion control is connected to the pulverizer at only one point—the damper in the primary-air duct. The pulverizer's own control system regulates all other functions, such as maintenance of proper fuel-air ratio and operating temperature.

SEND FOR DATA. For full information about the B&W Type EL Pulverizer and Pulverized-Fuel Firing Systems, write: The Babcock & Wilcox Company, Dept. P-1, 161 E. 42nd Street, New York 17, N. Y.



COAL RECIRCULATION — this means high fineness, aids drying.

PRESSURE SYSTEM — this eliminates fan wear, simplifies piping.

AIR CONTROL—this means one, simple control contact point.

MILL LEVEL CONTROL — this automatically adjusts fuel-feed.

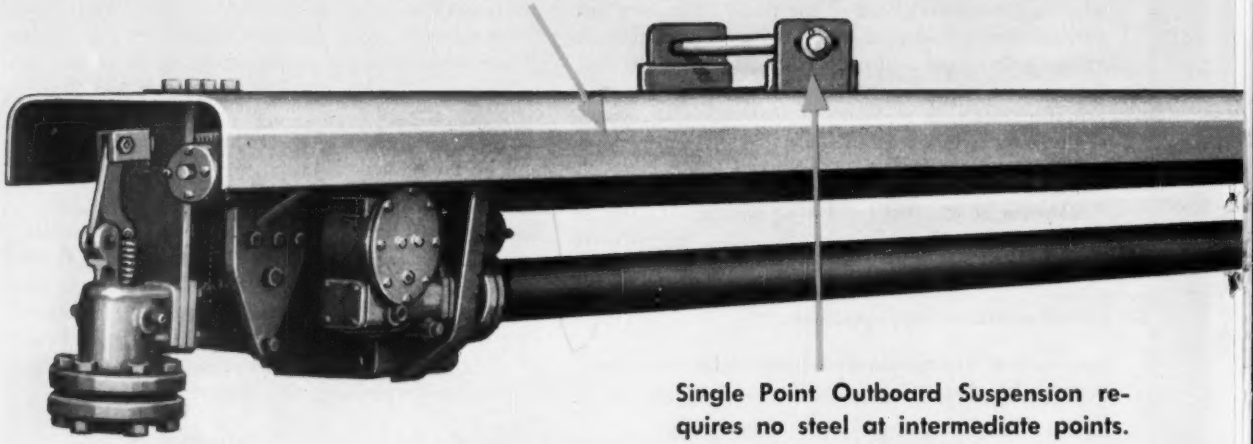
BABCOCK & WILCOX

BOILER DIVISION

G-766

Backbone and Protective Cover

Top Cover is an integral part of the structural "Backbone" of the blower unit that assures greater rigidity. It also provides protection from dirt, damage, the elements, and personnel hazard . . . with improved appearance.



Single Point Outboard Suspension requires no steel at intermediate points.

One of the most popular features of the new Diamond Series 300 IK Long Retracting Blower is the very substantial cover that is formed from steel plate. It is much more than just a cover in the ordinary sense . . . it is also an integral part of the structural backbone of the blower that provides maximum rigidity without excessive weight.

This is only one of many important features (see box on right hand page) of the new Series 300 IK that is establishing a new standard of efficiency, economy and dependability in cleaning those heating surfaces that require a long retracting blower. For further information about the new Series 300 IK, ask the nearest Diamond office for Bulletin 2111U.

Diamond

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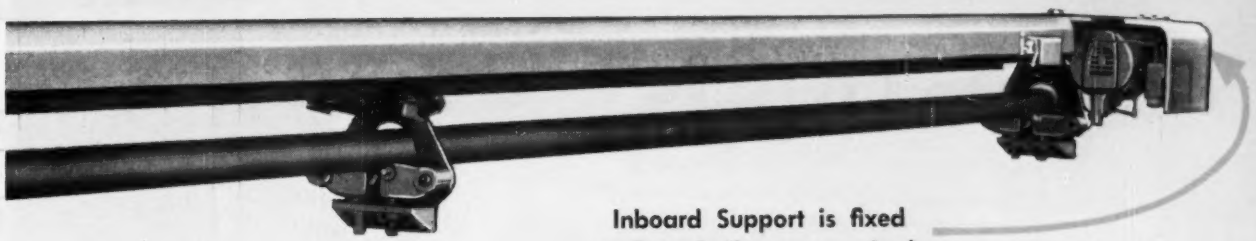
ANOTHER IMPORTANT FEATURE of the NEW Diamond SERIES 300 IK LONG RETRACTING BLOWER



Inboard Support is fixed or from boiler, as required.

"YOU CLEAN BOILERS BETTER AND AT LOWER COST WITH DIAMOND BLOWERS"

OTHER ADVANTAGES OF SERIES 300 IK BLOWERS

- Front End Single-Motor Drive
- Compact, Accessible Electric or Air Power and Control Terminal Facilities
- Nozzle-Sweep-Every-Inch Cleaning Pattern
- Improved "Type A" Nozzle
- Positive Gear Carriage Drive
- Poppet Valve with Adjustable Pressure Control
- Positive Mechanically Operated Valve
- Single Point Outboard Suspension
- Oversize Lance (Step-Tapered for Extra Long Travel)
- Auxiliary Carriages for Extra Long Travel
- Designed for Quick, Easy Servicing

No other blower gives you all these advantages.

7697

A question for every electric utility

CAN LOAD GROWTH BE HANDLED WITH LOWER INVESTMENT COSTS?

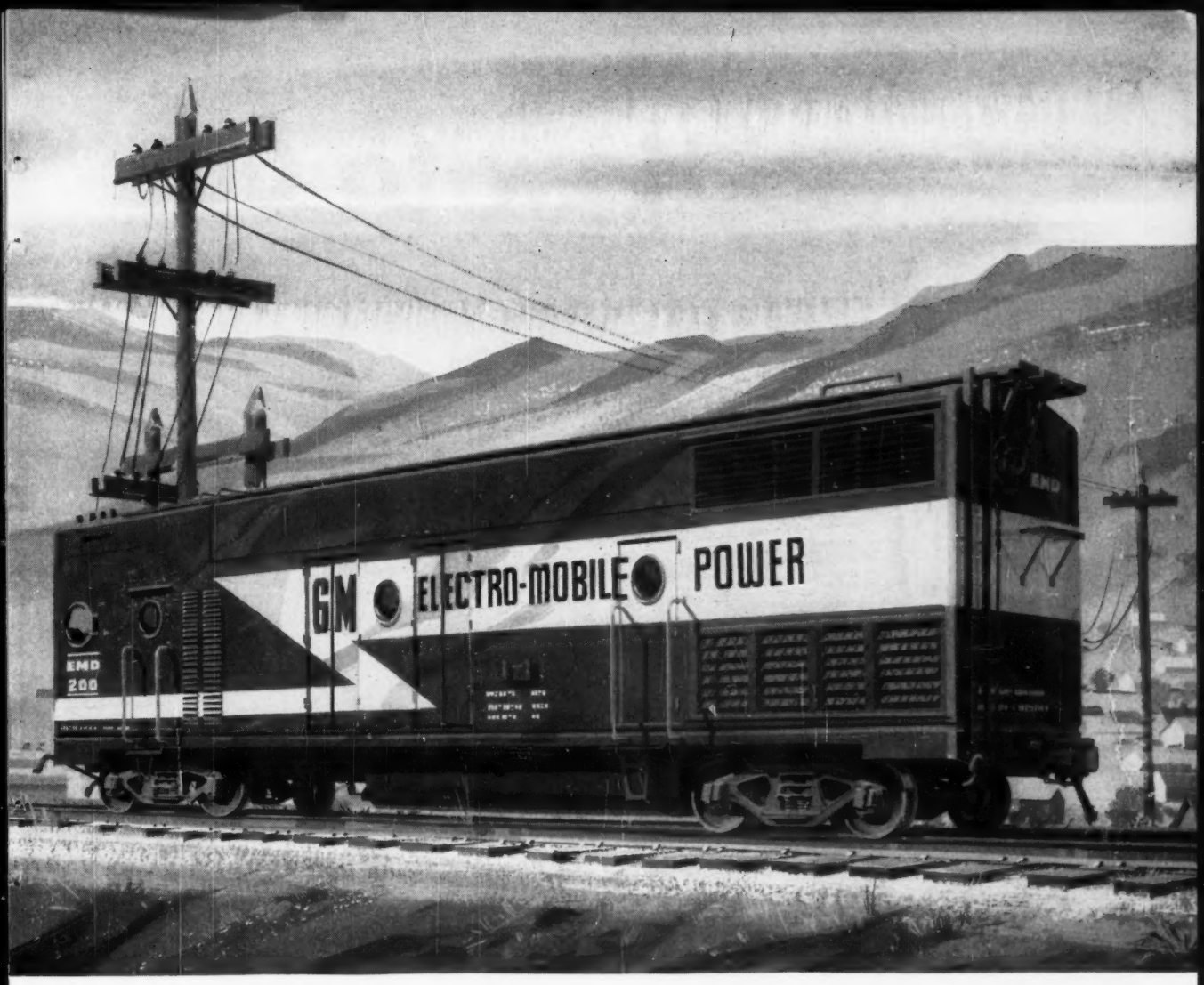
Our unequivocal answer to this question is, "Yes . . . and with greater power flexibility too."

Demand for electric power cannot always be controlled. Today's budding load growth area may well fall short of tomorrow's expectations.

The point is this: planning for increased power facilities necessarily precedes potential requirements by two to three years. Must, that is, unless a method can be devised that will permit the economic employment of units of power to handle load requirements as they develop, thus permitting a more realistic, longer-range selection of site and size for permanent installations.

Electro-Mobile Power provides the base for just such a program. It can be moved from one load center to another. It can be used in multiples to handle either building or diminishing demand. In short, it can follow the demand until such time as it becomes economic to build permanent facilities in the most advantageous location.

Can load growth be handled with lower investment costs? We think joint analysis of your own growth plans is the shortest way to an affirmative answer. Let's discuss it. Contact your nearest Electro-Motive representative for details.



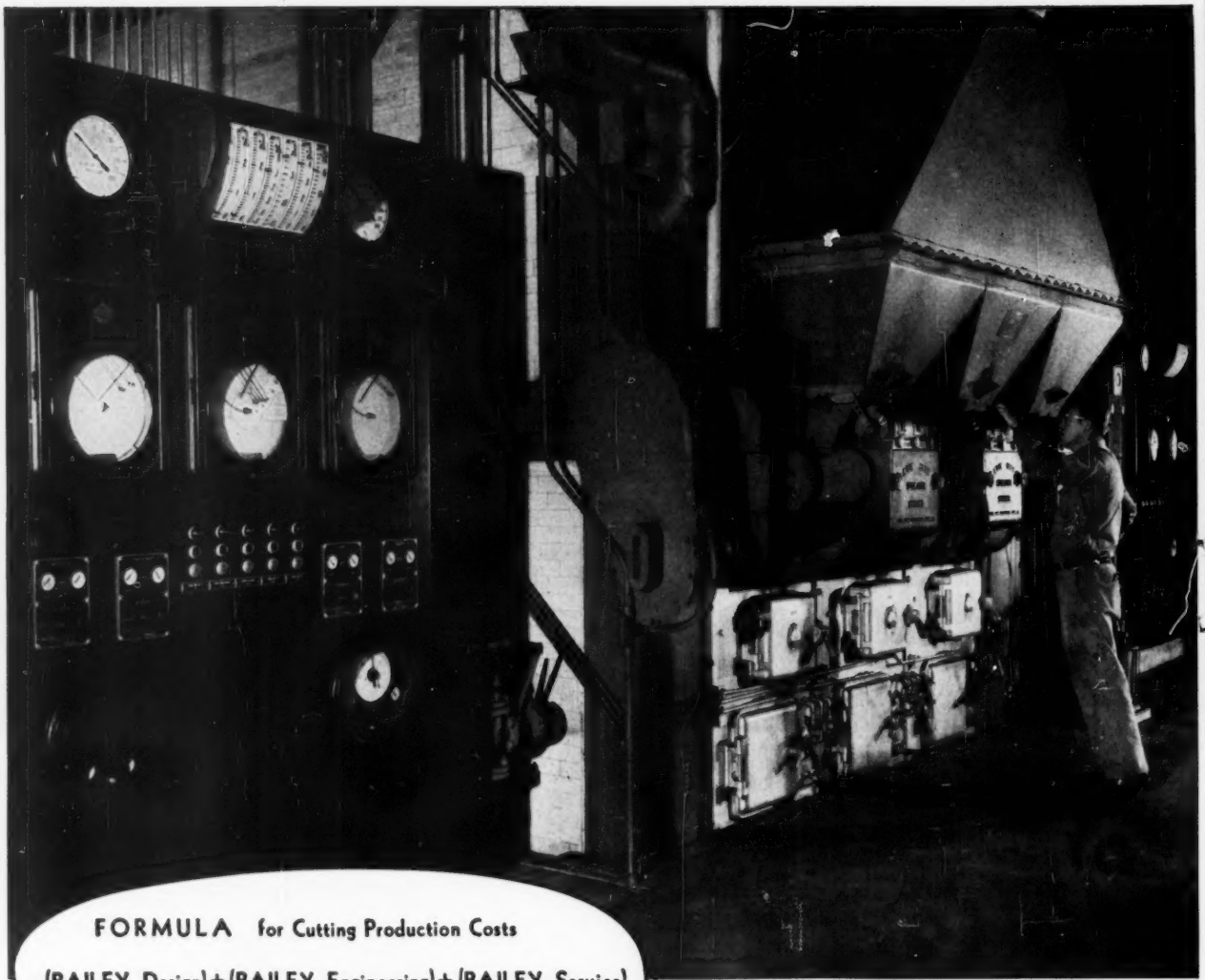
As demand increases in the load growth area, Electro-Mobile rail units like this can be added or subtracted in 1000 kw increments to match power requirements exactly, at lowest cost. After demand has been established, permanent facilities can be erected in the most economical and desirable location. Electro-Mobile units offer the most advanced electrical engineering, equipment and controls. Rail units may be placed on sidings as shown here or mounted on piers for semi-permanent use.

Electro-Mobile trailer unit is remarkably adaptable to many temporary uses because of its quick mobility. Trailer units have 500 kilowatt capacity.

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS LA GRANGE, ILLINOIS

Sales Offices in Chicago, New York, St. Louis, San Francisco

How to Cut



FORMULA for Cutting Production Costs

(BAILEY Design) + (BAILEY Engineering) + (BAILEY Service)

= GREATER SAVINGS PER FUEL DOLLAR

At the heating plant of Lincoln Electric Co., Euclid, Ohio Bailey Control helps to cut operating costs by:

1. Controlling the rate of combustion in two spreader stoker-fired hot water boilers to maintain the desired temperature of outlet water.

2. Controlling fuel-air ratio at each boiler by means of a unique Btu-Air Flow meter which maintains most economical use of fuel.

3. Controlling quantity of water by-passed around boilers, thus tempering water supplied for heating in accordance with changes in outside temperature.

Operating Cost

★ When your plant is operating at peak efficiency, unit production costs are low. But outages of any kind upset the balance. As efficiency drops, and/or outages occur, overhead costs impose an increasing burden—bring on dollar losses that can't be recovered.

That's why you can use Bailey Co-ordinated Control Systems to advantage. Here are three reasons why Bailey systems are the best you can buy:

1. Complete Range of Equipment—fully co-ordinated

You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control *systems*.

2. Engineering Service—backed by experience

No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement, and automatic control.

3. Direct Sales-Service—conveniently located near you

Bailey Meter Company's sales service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

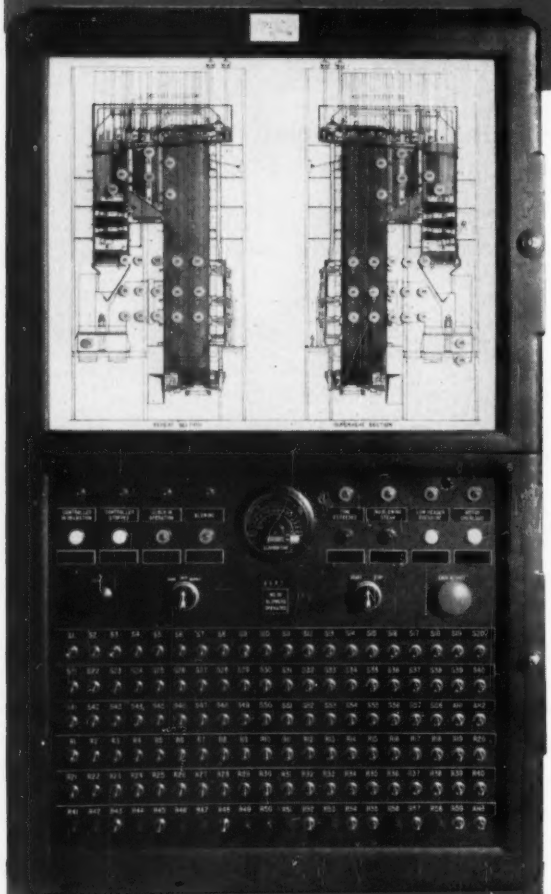
For lower operating cost—for more power per fuel dollar, less outage, and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More Power To You!"

A-119A-2

BAILEY
METER COMPANY
1036 IVANHOE ROAD
CLEVELAND 10, OHIO
Complete Controls for Steam Plants

BAILEY METERS
Controls for
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL

It's Vulcan Selective Sequence for Astoria Station's 2,400,000 lb./hr. Boiler!



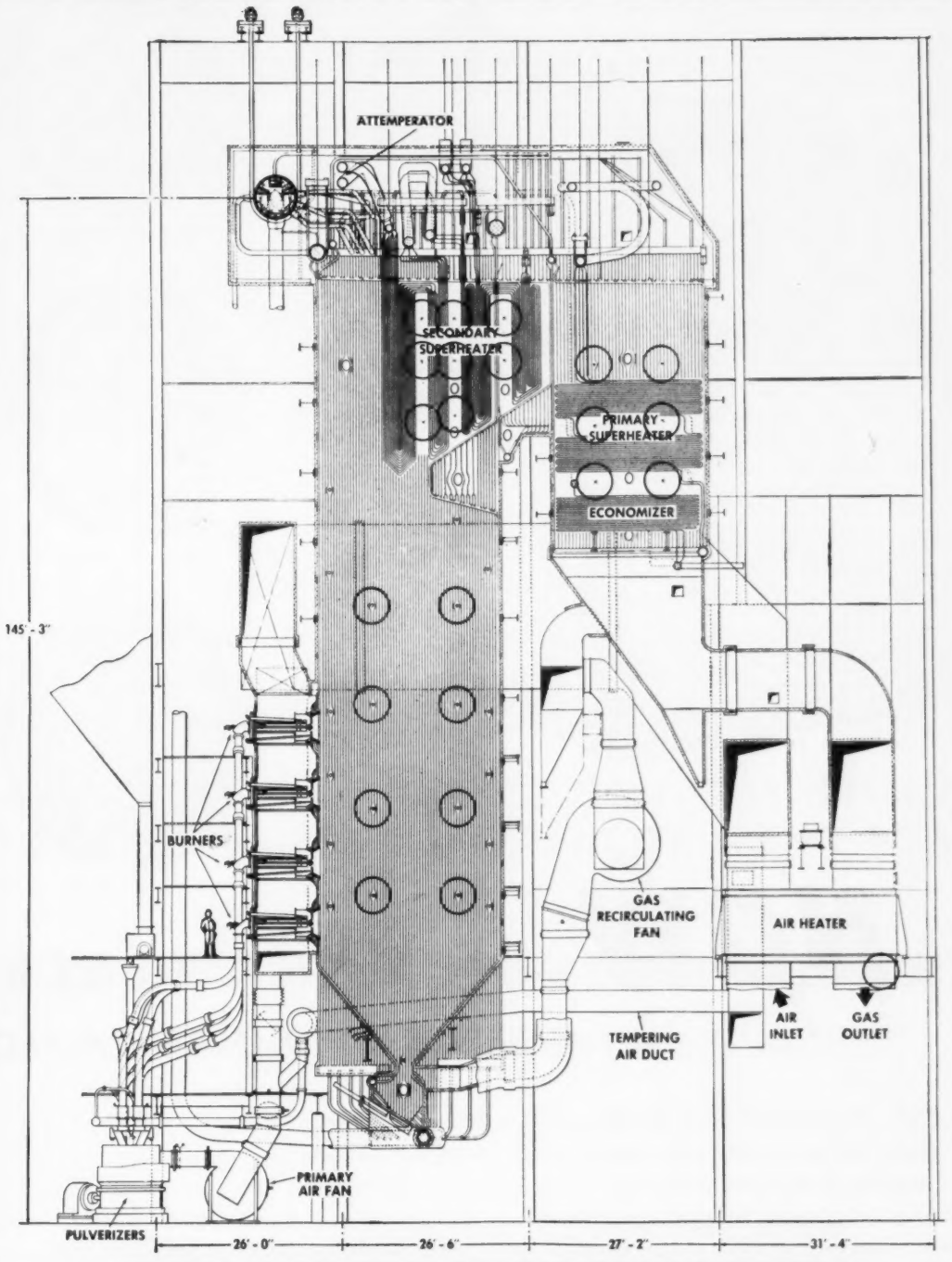
NERVE CENTER of the Selective-Sequence system is a completely pre-wired, factory-assembled controller for the soot blowers in each furnace. Selective Sequence lets operating personnel select the proper blowing sequence for most effective boiler cleaning. The operator can tell at a glance which blowers are operating, time elapsed, number of blowers that have operated, and any malfunction of equipment or blowing medium.

Each of the two forty-foot furnaces firing Consolidated Edison's Boiler 30 at Astoria Generating Station will be equipped with a custom-designed Vulcan Selective-Sequence Soot Blowing System. The boiler now being built by Babcock & Wilcox is a radiant-reheat type to be fired by pulverized coal, oil or gas.

Drive for the soot blower systems will be electric; the blowing medium steam. Both Vulcan long retractable soot blowers and wall deslaggers are included in the system. Vulcan wall deslaggers maintain high striking power, keep thickness of deposits to a minimum.

Whether your boiler is large or small, power or process—a modern Vulcan Soot Blower System with automatic-sequential or selective-sequence control will keep it operating at peak efficiency. Your Copes-Vulcan representative has the ideas, information and experience to help you choose the system best suited to your needs.

COPES-VULCAN DIVISION
BLAW-KNOX COMPANY
ERIE 4, PENNSYLVANIA

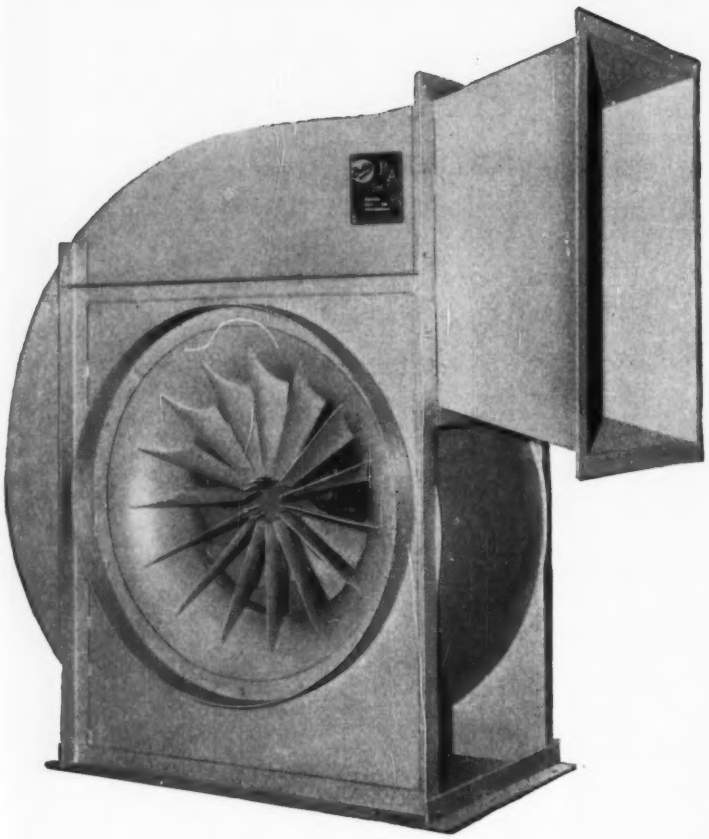


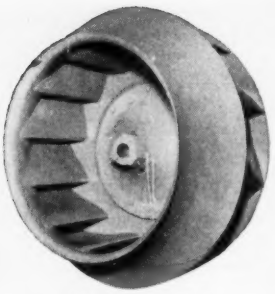
CONSOLIDATED EDISON COMPANY

ASTORIA GENERATING STATION, NEW YORK, NEW YORK

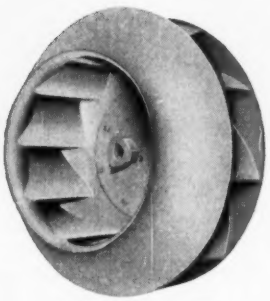
BABCOCK & WILCOX TWIN-FURNACE BOILER
2—40'-0" FURNACES

Capacity, Lb. Steam per Hour...2,400,000 Superheater Outlet Pressure, PSI.....2,150
Design Pressure, PSI.....2,500 High Pressure Steam Temperature, F..1,050
Reheat Steam Temperature, F.....1,000





TYPE "BA" WHEEL



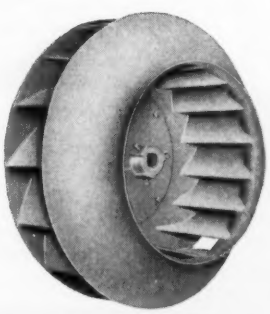
TYPE "CA" WHEEL

TYPE "AA" WHEEL

NOW—PICK THE FORCED

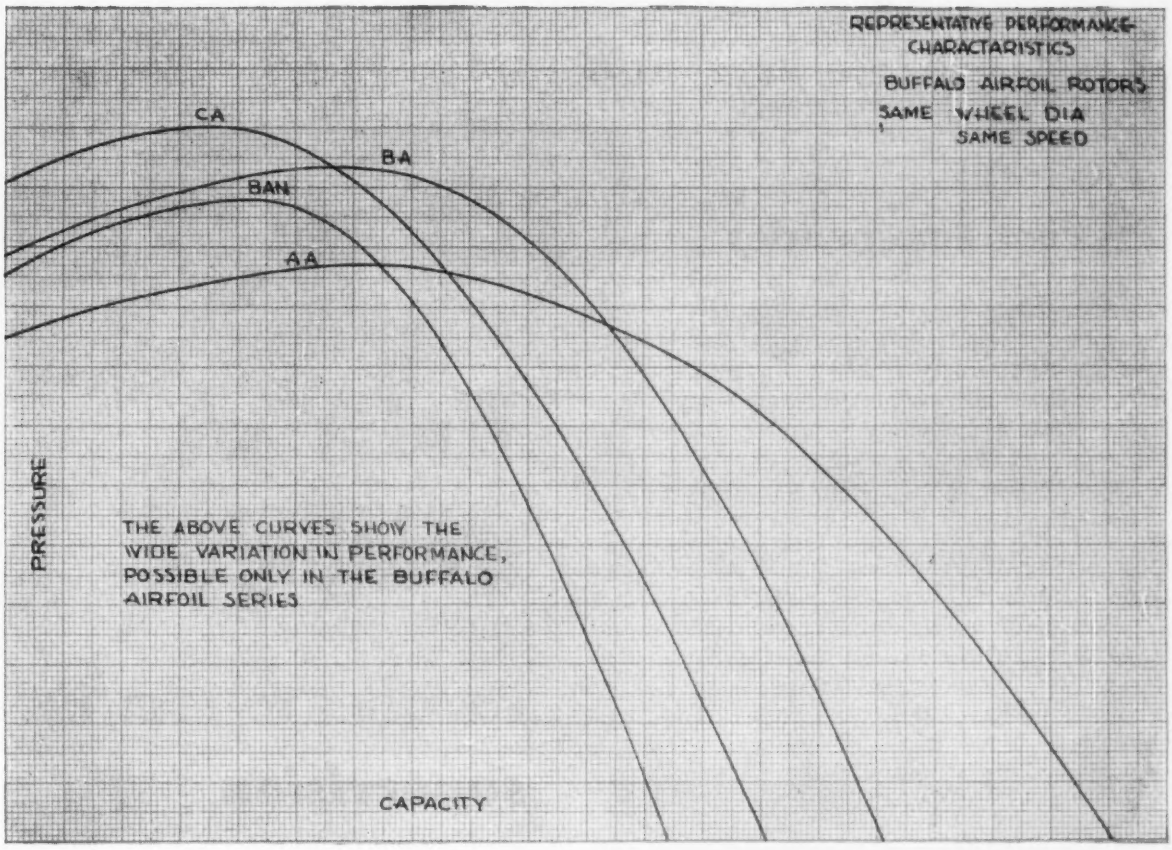
4 SERIES OF "BUFFALO" AIRFOIL

1. "BA", the basic wheel of the line — for many general forced draft and industrial requirements. Note broad air channels provided by extra-wide blades.
2. "CA", a wheel for higher pressures and lower capacities.
3. "AA", for lower pressures and higher capacities.
4. SEMI-AIRFOIL WHEELS like the "CLM", with airfoil noses and single thickness backward curved blades, closely approach performance of full airfoil wheels. This wheel has a definite application where a single thickness is advantageous.



TYPE "CLM" WHEEL

ALL WHEELS VARIABLE AS TO WIDTH, TO GIVE YOU PEAK EFFICIENCY FOR *YOUR* OPERATING CONDITIONS



ONLY "BUFFALO" BRINGS YOU THIS BROAD SELECTION—PLUS EFFICIENCIES UP TO 92%

DRAFT PERFORMANCE YOU WANT

FANS TO MATCH YOUR CONDITIONS EXACTLY

Not just an airfoil fan, but *four complete series* — six types of interchangeable airfoil and semi-airfoil wheels in varying widths — to give you maximum efficiency for your operating conditions! "Buffalo" deep-blade airfoil design offers a new high in forced draft efficiency — not just on paper, but in actual operation. In addition to the effective, high-strength airfoil and semi-airfoil blades, these "Buffalo" Fans go beyond the usual concept of streamlining. From the smoothly rounded inlet to the divergent outlet, all sources of turbulence has been eliminated. If you wish the highest possible efficiency in a forced draft fan tailor-made for your particular operation, by all means, write for Bulletin FD106 and our engineering recommendations.

BUFFALO FORGE COMPANY
BUFFALO, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

Frequent Instrument Check-ups Prevent Emergencies

The economical way to protect your investment in instrumentation is a Honeywell Periodic Service Plan. Under this plan, a Honeywell service specialist comes to your plant at regular intervals to—

— Check your Brown instruments and calibrate them against accurate laboratory standards.

— Inspect all moving parts, clean and lubricate them, and replace where necessary.

You get this kind of service performed regularly for your office equipment such as typewriters and calculating machines . . . for your automobile . . . and even for yourself by periodic check-ups by your doctor. You've learned that the ounce of prevention is a good investment. Well, the same philosophy applies to instruments, too. Keeping them in good condition is far more economical than waiting for emergencies to throw production schedules into a tailspin.

Here, briefly, is what the Honeywell Periodic Service Plan does. It provides you—

Periodic examination and adjustment by a factory-trained service engineer.

Automatic attention. Calls are made on a schedule that fits your own plant's requirements . . . at a cost substantially lower than an equivalent emergency service call.

Continuous operation. Good instruments kept in top condition can be counted on for steady duty, without costly shut-downs. Well-maintained instruments last longer, too.

Increased plant efficiency. Greater reliability of operation builds confidence of plant personnel in their equipment.

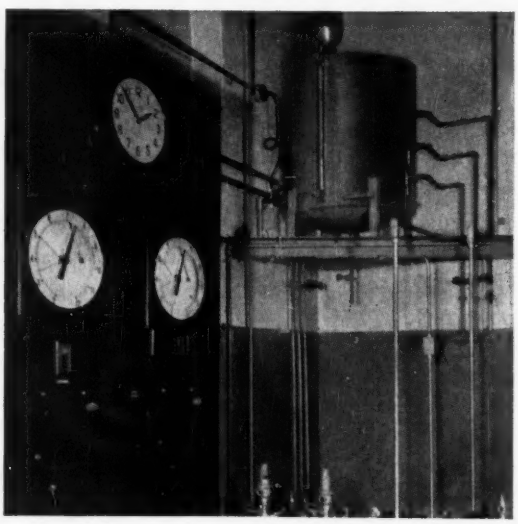
At any time, of course, you can count on prompt emergency service from any one of the more than 100 Honeywell service centers spotted throughout the United States and Canada.

The Plan is extremely simple. It costs remarkably little, and can pay real dividends in protection of your production schedules and your instrument investment. For details about how it can be applied to your own plant, call your local Honeywell office.

Water treating . . .

reduced to routine supervision

by Honeywell



Shown on the water treatment control panel at James Lees and Sons Co., Bridgeport, Pa., are two ***ElectroniK*** *pH indicator-recorders, one with* ***Electr-O-Line*** *control for the caustic feeding system.*

Water treatment plant at the Alan Wood Steel Co., Conshohocken, Pa. In the pump room, Honeywell flow meters, level and pressure gages control the flow of recirculated mill and river water through the treatment process.

instrumentation

At the Alan Wood Steel plant, Honeywell instrumentation was applied to treat waste, as well as to condition incoming river water for mill requirements—a total of 20 million gallons per day. Overall plant efficiency is increased, and maintenance is reduced. By providing a constant supply of uniform water, Honeywell controls effect savings throughout the plant, and permit closer control of process temperatures and pressures. Controlled waste discharge contributes to good community relations.

At the James Lees and Sons plant, water is supplied at the rate of a million gallons per day from the highly turbid Schuylkill River. Until Honeywell instrumentation was installed, variations in volume, turbidity, percentage of suspended solids and concentration of pollutants posed serious troubles. Now, Honeywell controls provide consistently clear water at pH 8. Alum requirements have dropped 90%. Double shifts are no longer needed in the treatment plant. Night and Sunday trouble-shooting by the superintendent is eliminated.

You can save time, trouble and materials—and end water treatment difficulties—with Honeywell automatic controls. Two cases in point: a textile plant with the problem of treating incoming river water, and a steel mill requiring special treatment of both incoming water and waste. In both instances, Honeywell controls provided profitable solutions.

Honeywell instrumentation is now serving in hundreds of industrial and municipal water treatment and waste discharge processes. In every case, it offers closer control and higher efficiency of water treatment. Regardless of your specific need, Honeywell instrumentation can save you money, both directly and in end benefits. Contact your nearby Honeywell sales engineer for help with your water or waste treatment problems . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

H HONEYWELL

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls

BURLINGTON, VT. ELECTRIC LIGHT 100,000 LBS. PER HOUR WICKES IN THE NEW POWER PLANT

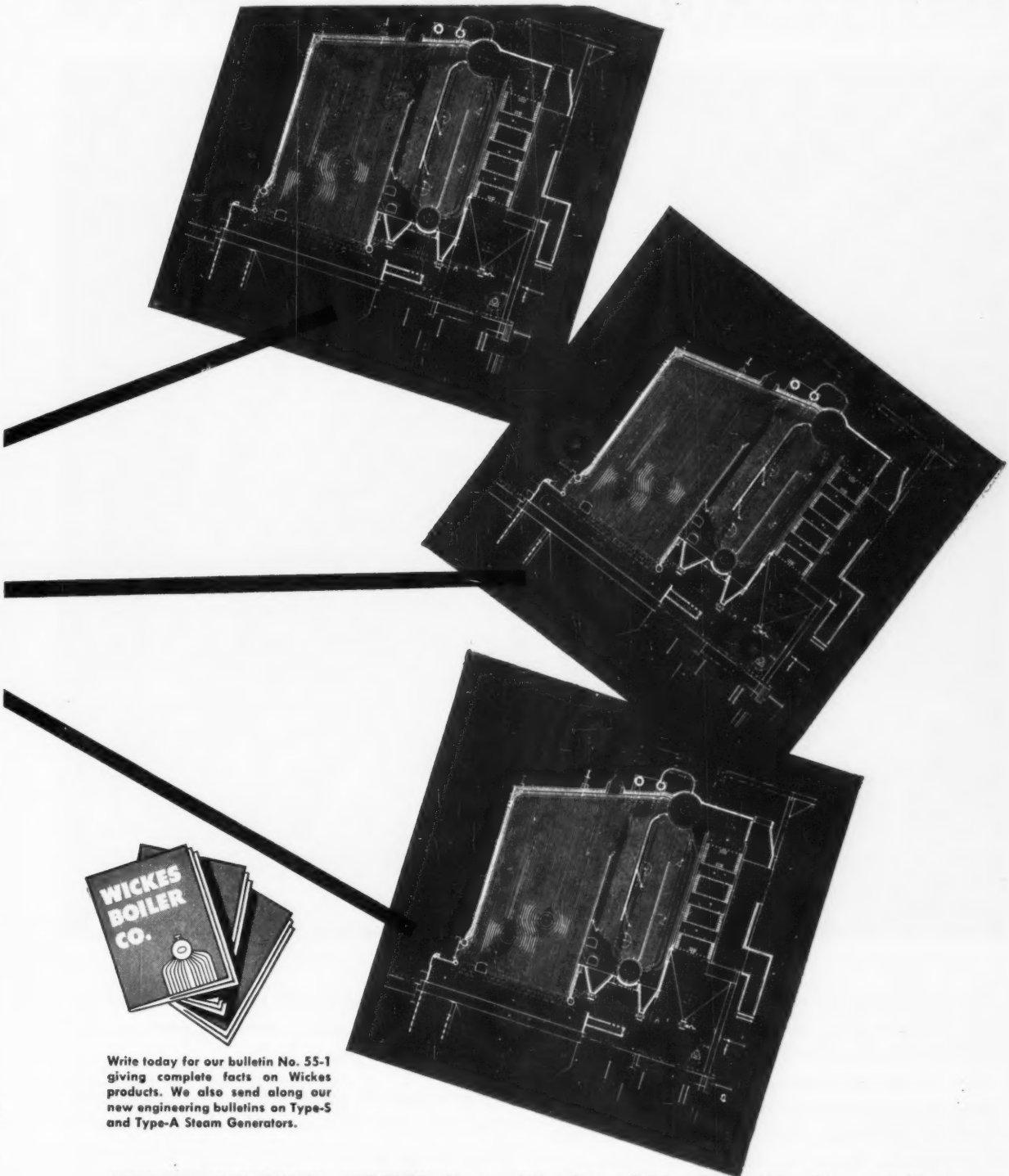
At the modern plant of the Burlington, Vermont Electric Department, three Wickes type R steam generators provide a powerful and unfailing steam supply. Each unit delivers 100,000 pounds of steam per hour, contains 7480 square feet of boiler heating surface, and 2320 square feet of water wall heating surface. Each steam generator is equipped with a superheater, airheater and economizer. These boilers have a design pressure of 1000 psi. This modern plant is operated by the Green Mountain Power Corporation. Superintendent of Burlington's Electric Light Department is W. A. Stebbins.

THE WICKES BOILER CO.

DIVISION OF THE WICKES CORPORATION

SAGINAW, MICHIGAN

DEPARTMENT INSTALLS THREE TYPE R STEAM GENERATORS



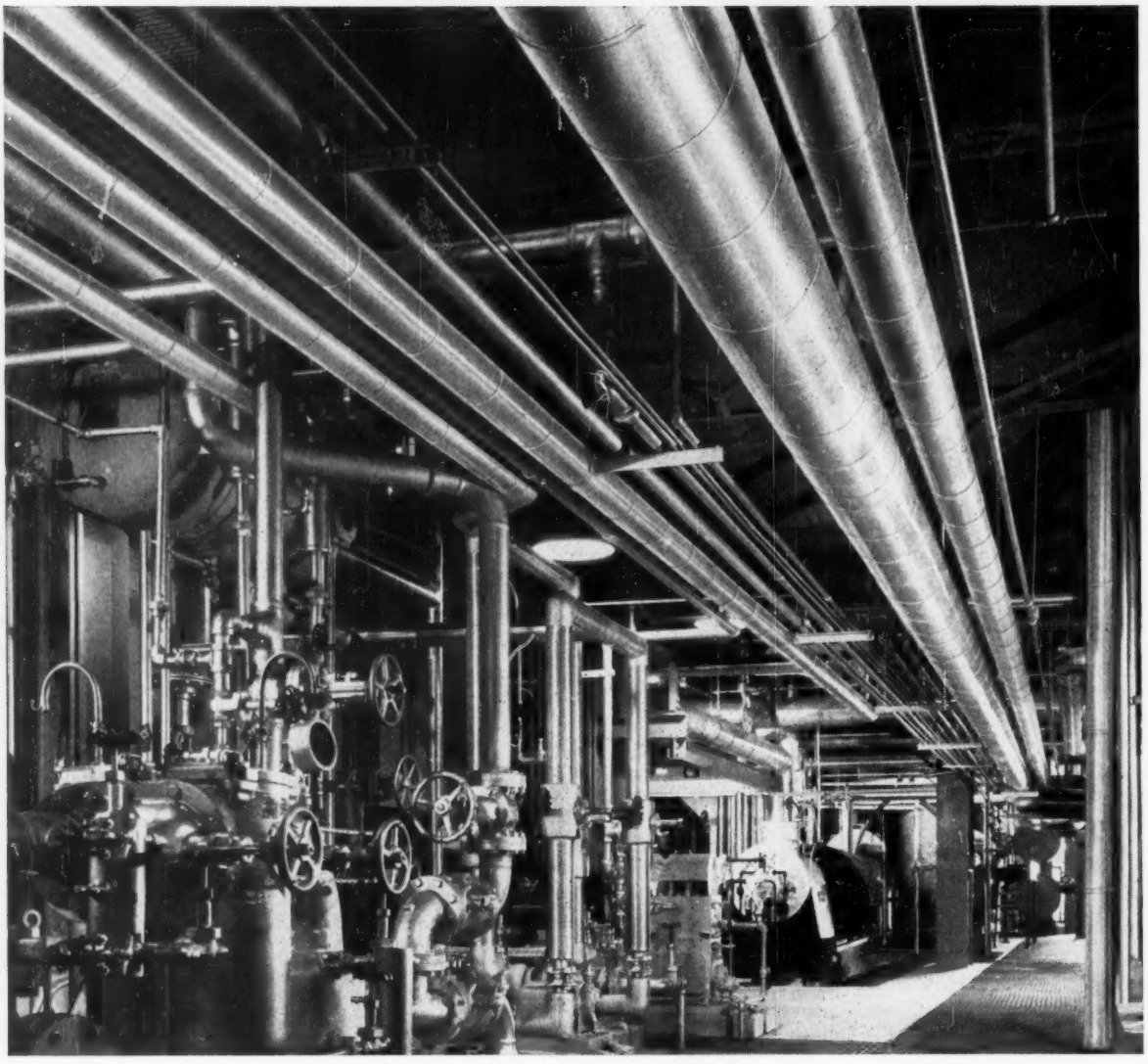
Write today for our bulletin No. 55-1 giving complete facts on Wickes products. We also send along our new engineering bulletins on Type-S and Type-A Steam Generators.

RECOGNIZED QUALITY SINCE 1854 • ***SALES OFFICES:*** Albuquerque, N.M. • Boston • Buffalo • Charlotte, N.C. • Chicago • Cleveland Dallas • Denver • Detroit • Fort Wayne, Ind. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City Portland, Ore. • Saginaw • Salt Lake City • San Francisco • Springfield, Ill. • Tulsa • Washington, D.C.

164

Kaiser Aluminum snap jackets give you

A NEW, FASTER WAY TO



Now, with *snap jackets* made with Kaiser Aluminum, one man can install aluminum pipe jacketing quickly and economically.

An outstanding example of recent improvements in aluminum jacketing techniques, the *snap jacket* is a sheet of Kaiser Aluminum, roll-formed into a tubular shape and stiffened along one edge by an angular crimp. Rigid, but sufficiently flexible, the jacket can be quickly snapped into place around insulated pipe by only *one man* and assures a more durable, more weather-tight installation.

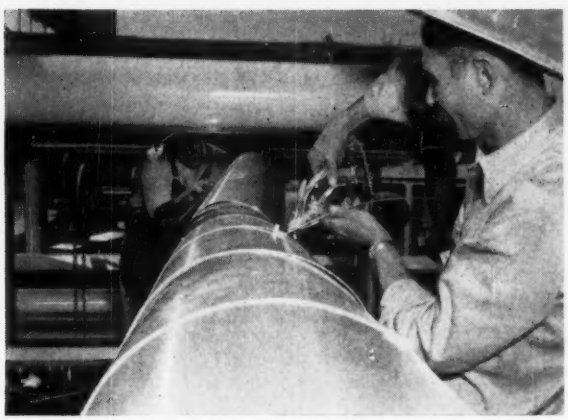
Because it is made with Kaiser Aluminum, the *snap jacket* gives you improved appearance and longer life at low cost.

For immediate assistance on any jacketing requirements, call the Kaiser Aluminum sales office listed in your phone directory. Process Industries Department, Kaiser Aluminum & Chemical Sales, Inc., *General Sales Office,* Palmolive Bldg., Chicago 11, Illinois; *Executive Office,* Kaiser Bldg., Oakland 12, California.

INSTALL ALUMINUM JACKETING

1. ONE MAN can quickly position tubular *snap jacket* for installation.

2. NEXT, same man easily snaps *snap jacket* around pipe, places laps properly and bands the jacket to complete the job.



3. TO SAVE even more time, two men can work together . . . one man snaps jackets in place, follow-up man bands them.

For this new, faster way to install aluminum jacketing, Kaiser Aluminum alloy 5005-H16 is recommended. Other alloys may be used depending on the job, but it is desirable to use one alloy throughout.

Recommended thicknesses of sheet aluminum:

For insulation O.D. of 12.75" and under	**0.020"**
For insulation O.D. of 14" and larger	**0.024"**

Kaiser Aluminum

materials for the process industries

For *complete* information about aluminum jacketing with illustrated on-the-job techniques, send for the new 40-page *free* manual "Kaiser Aluminum Insulation Jacketing Materials And Methods."

MAIL THIS COUPON TODAY!

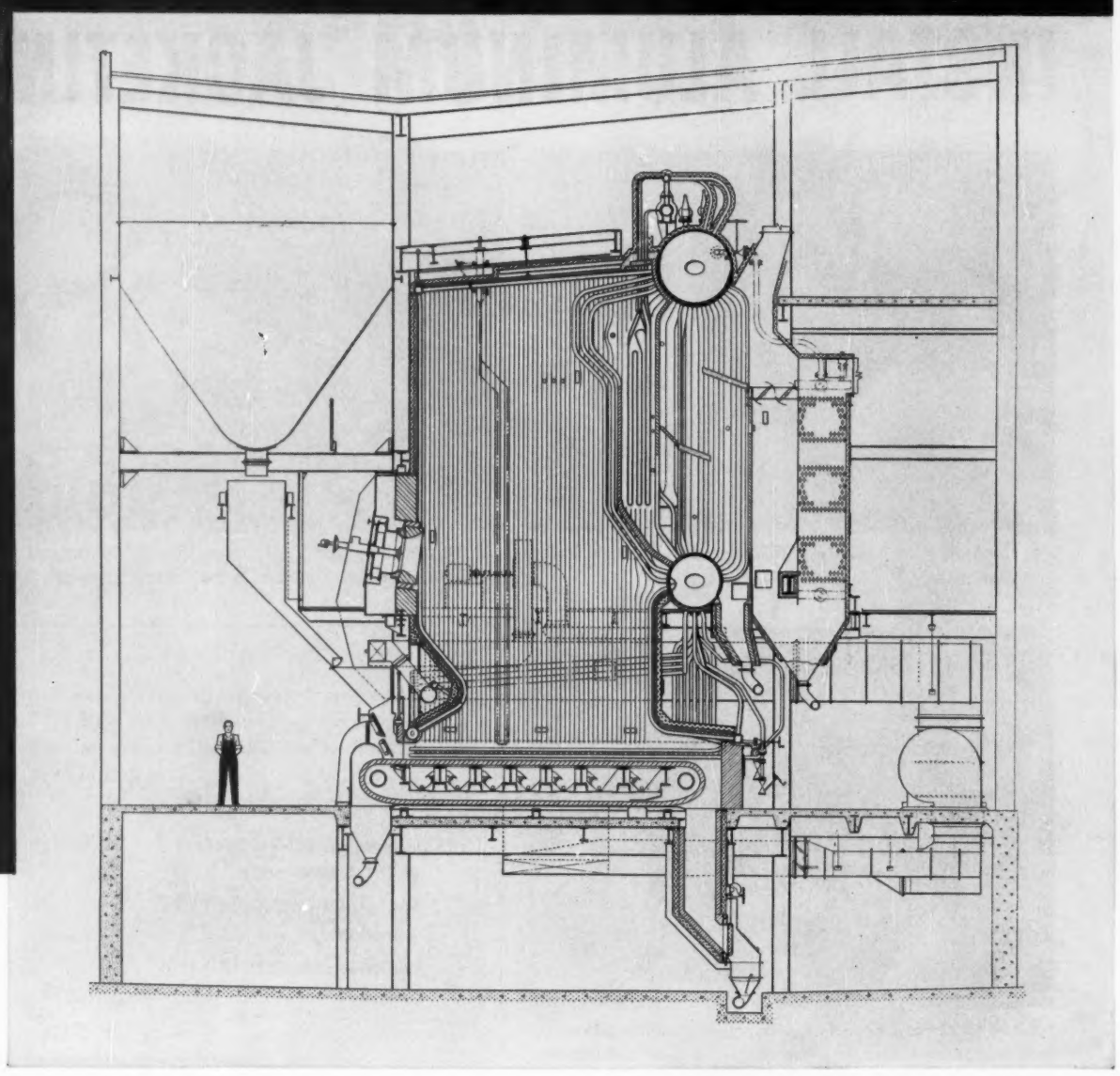
KAISER ALUMINUM & CHEMICAL SALES, INC.,
Process Industries Department, Room 8112
1924 Broadway, Oakland 12, California

Please send my copy of your new manual "Kaiser Aluminum Insulation Jacketing Materials And Methods." I understand there is no obligation.

NAME_____ TITLE_____

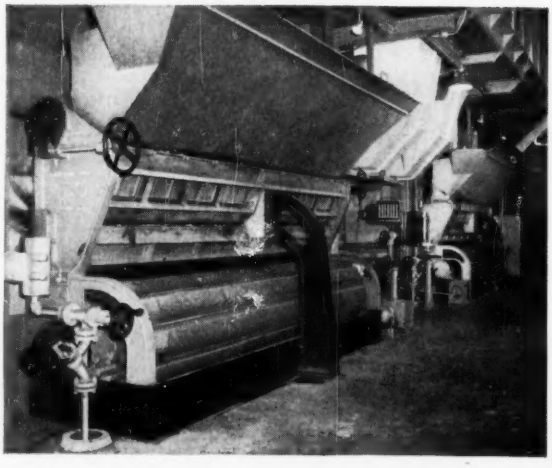
COMPANY_____ ADDRESS_____

CITY_____ STATE_____



Cross-sectional elevation of the C-E Vertical Unit Boiler, Type VU-50X, installed in the Mill Division Plant of the Central Fibre Products Company, Quincy, Illinois. There are two units, each fired with a C-E Traveling Grate Stoker and designed for the future use of oil or gas as alternate fuels.

Present operating conditions are 185 psi and 450 F. Each unit has a maximum continuous capacity of 85,000 lb per hr and a four hour peak of 100,000 lb per hr. The boilers are designed for 650 psig and in the future will operate at 610 psig and 650 F.



Firing aisle at the Central Fibre Products Mill Division plant at Quincy, Ill. This is a front end view of two C-E Traveling Grate Stokers which fire the VU Boilers as shown by the cross-sectional elevation drawing.

VU Boilers exceed performance guarantees

at Central Fibre Products Co.

Plant designed by H. M. Wilson Company, Inc., Philadelphia, Pa., Engineers.

The two C-E Vertical Unit Boilers installed in this plant have exceeded their guaranteed efficiency of 82.6% and guaranteed peak capacity of 100,000 lb steam per hr. These stoker-fired units are equipped with a C-E overfire air system that *works to perfection* by completely burning out all combustibles at the proper point, allowing for a *very clean furnace.* There is *absolutely no smoke* from the stacks. Furthermore, the draft loss of each unit—as well as the flue gas temperature leaving the economizer—is lower than the customer expected.

The above comments are all contained in a report written by the H. M. Wilson Company, Inc., Consulting Engineers to the Central Fibre Products Company, of Quincy, Illinois. Of course, it won't hurt to get the opinion of the customer, too, if you're interested. They will be very happy to discuss their boiler installation with you.

Incidentally, when you need boilers, please consider the fact that Combustion has a complete line of steam generating and fuel burning equipment suitable for any pressure, temperature and fuel requirement.

COMBUSTION ENGINEERING

B-967

Combustion Engineering Building

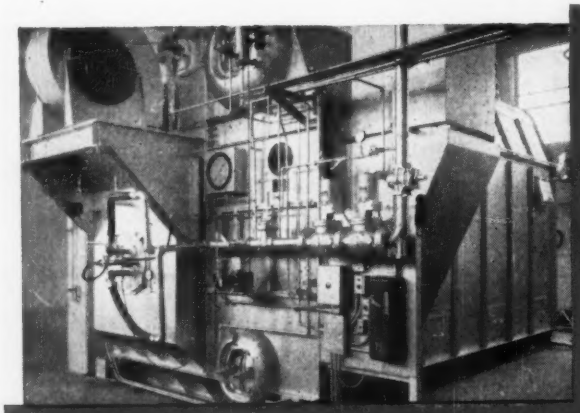
200 Madison Avenue, New York 16, N. Y.

Canada: Combustion Engineering-Superheater Ltd.

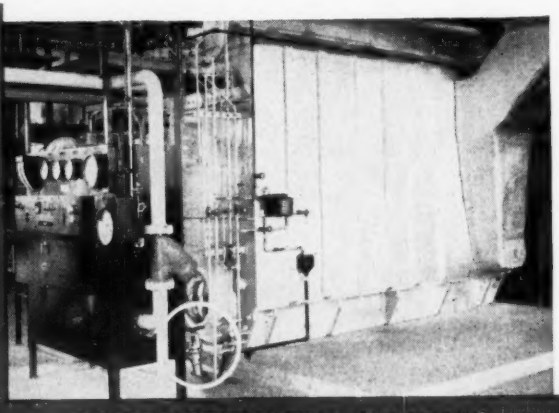
steam generating units; nuclear reactors; paper mill equipment; pulverizers; flash drying systems; pressure vessels; home heating and cooling units; domestic water heaters; soil pipe.

the blow-off valve trend on "package" boilers is

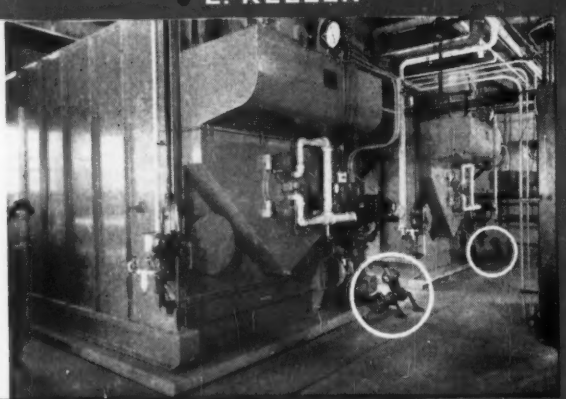
YARWAY SEATLESS



E. KEELER



COMBUSTION ENGINEERING



TITUSVILLE

KEWANEE-SPRINGFIELD

YARWAY® BLOW-OFF

■ More and more leading manufacturers of package-type boilers are featuring Yarway Blow-Off Valves on their units. Many are standardizing on Yarways.

The reason—good blow-off valves help good package boilers *perform better*.

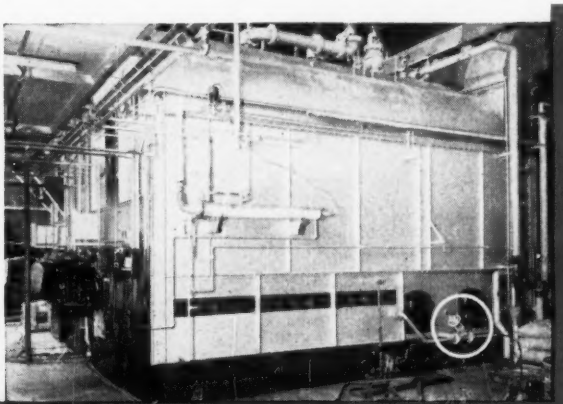
Yarway—known for nearly 50 years for *quality* blow-off valves—offers advanced design, dependable service, and reasonable cost . . . three features attractive to all boiler users.

The Yarway Seatless Blow-Off Valve, with balanced hollow sliding plunger and no seat to score, wear, clog or leak, is the most widely used valve for low and medium pressures.

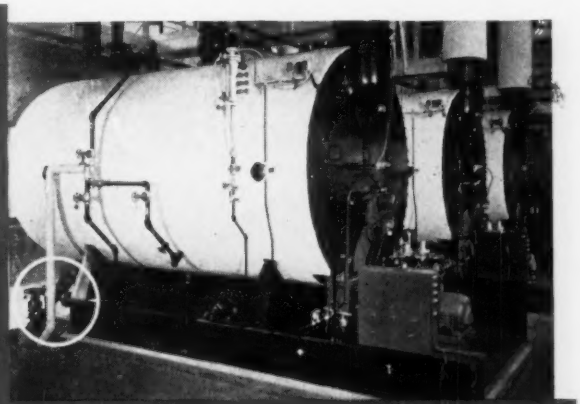
Specify Yarway Seatless Blow-Off Valves on your package boilers. All boiler makers will supply them.

For full description of Yarway Seatless Blow-Off Valves write for Yarway Bulletin B-426.

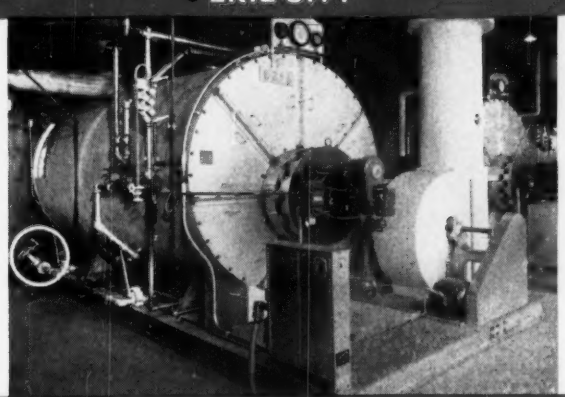
YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES



● ERIE CITY



● CLEAVER-BROOKS



● PREFERRED UTILITIES

● **Yarway Seatless Tandem Blow-Off Valve** (angle-straightway combination) with angle valve sectioned to show balanced sliding plunger design.

● **Yarway Seatless Tandem Blow-Off Valve,** angle-angle combination, straightway-angle or straightway-straightway tandems also available.

VALVES

STEPHENS-

coal conveying systems

BULLETINS ON ANY OF

BELT CONVEYORS

VIBRATING CONVEYORS

REDLER
CONVEYORS, ELEVATORS

-ADAMSON

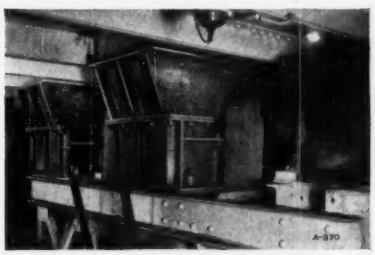
for TODAY and TOMORROW

The power plant built for present needs often is expected to serve the next generation, also. The men responsible for purchase of the plant's vital coal handling system may expect to buy only one such system in their lifetime. Their selection must be right—with no room for mistakes.

Such a system must function continuously, night and day, winter and summer, for years to come. It must provide rugged, flawless operation, be economical in installation and delivery costs, and must be sparing of manpower.

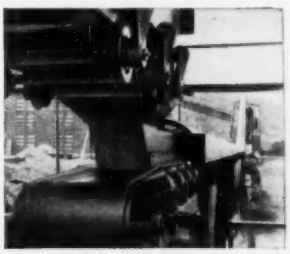
To create such a system demands the finest engineering, the best construction, and, above all, the greatest experience. These are S-A qualities and they have been earned in long service to the power field.

For today's generation, STEPHENS-ADAMSON coal handling systems help supply hundreds of thousands of precious kilowatt hours. They can be counted on to supply tomorrow's requirements, too. This is why, more and more, in coal handling systems, the big name is S-A, a name richly endowed with over 50 years of experience.



Knittel crushers built by S-A and used to reduce run-of-mine coal to stoker size. They are compactly constructed, requiring little headroom and are extremely dependable. S-A crushers are available in many sizes and variations to meet specific requirements.

S-A REDLER conveyors and elevators are patented products. They ideally move crushed coal over any plane, completely enclosed, eliminating all dusting problems. Specially designed flights move coal forward in a solid column. Discharge is possible at single or multiple stations.



Large coal volume can be handled with S-A belt conveyors at extremely low cost per ton and with minimum maintenance cost. Feeders supply coal from bins or track hoppers in uniform, easily controlled volumes.

S-A sales engineers have the full background and training necessary to provide wise counsel in all coal and ash handling problems. Call in the S-A man in your area or contact any of the three STEPHENS-ADAMSON main office-plants direct.

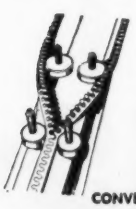
STEPHENS-ADAMSON MFG. CO.

5 RIDGEWAY AVENUE, AURORA, ILLINOIS
LOS ANGELES, CALIFORNIA
BELLEVILLE, ONTARIO

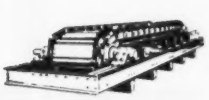
S-A manufactures a wide range of material handling products in three complete plants in U. S. and Canada.

- Belt Conveyors
- Belt, Pan and Plate Feeders
- Ship Loading Boom Conveyors
- Stacking Conveyors
- Storage and Reclaiming Systems
- "Natural Frequency" Vibrating Conveyors
- REDLER Conveyor-Elevators
- ZIPPER Conveyor-Elevators
- Conveyor Belt Cleaners
- Headshaft Holdbacks
- Grizzlies and Screens
- Centrifugal Pilers
- Bin Gates and Tunnel Gates
- Car Pullers and Spotters
- Bucket Elevators
- Skip Hoists
- SEALMASTER Ball Bearing Units

THE EQUIPMENT SHOWN HERE WILL BE SENT ON REQUEST

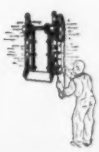


ZIPPER CONVEYOR-ELEVATORS

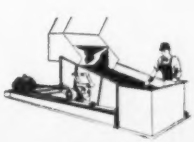


PAN CONVEYORS

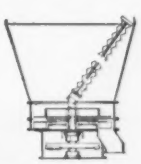
BUCKET ELEVATORS



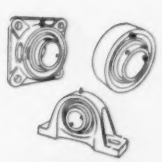
BIN GATES—ALL KINDS



VIBRATING SCREENS

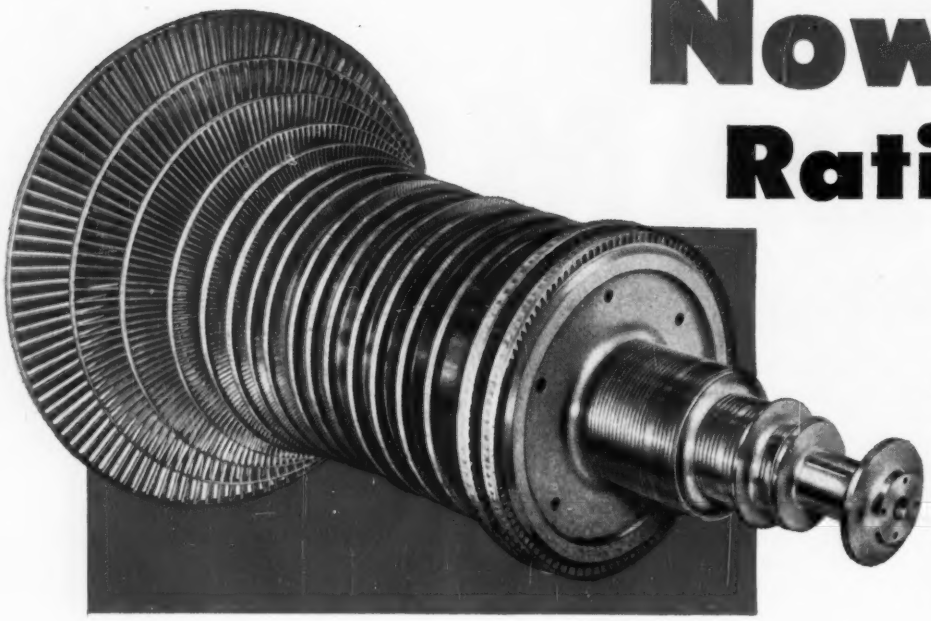


CIRCULAR BIN DISCHARGERS



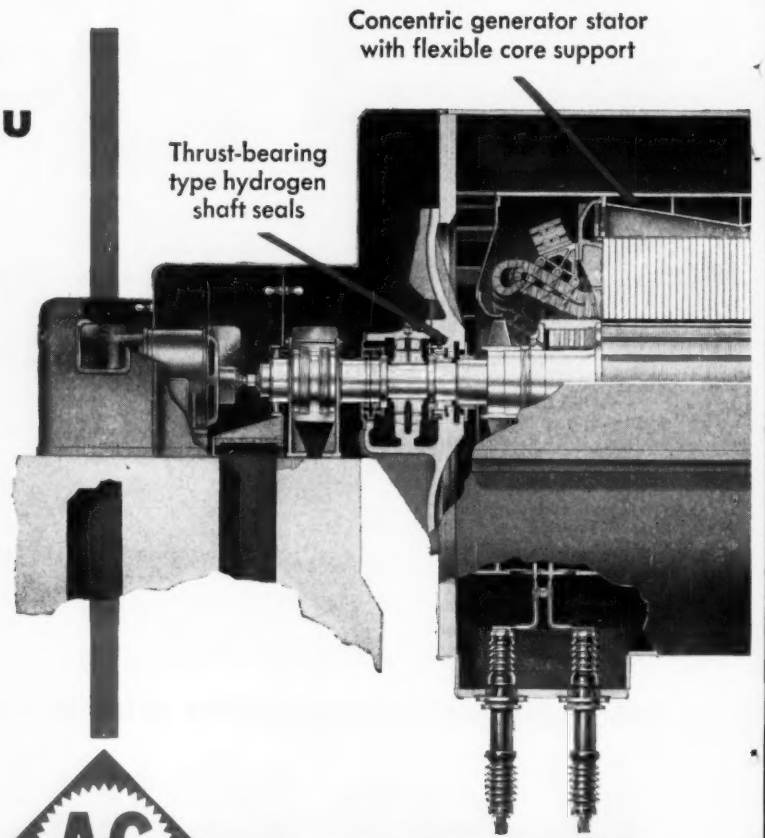
SEALMASTER BALL BEARING UNITS

Now in Ratings



Here is the turbine rotor for one of the 16,500-kw units now being built. For this 850-psig, 900-F AIEE-ASME turbine, rotor shaft and wheels are of integrally forged construction.

Allis-Chalmers Turbines Give You MORE Modern Design Features



CUTAWAY VIEW of 16,500-kw unit shows the development of impulse turbine design for larger ratings.

A-C ALLIS-CHALMERS

ALLIS-

Production up to 16,500 Kw

NEW Large WA-Series Turbines Offer

Advanced ● **Design Features**

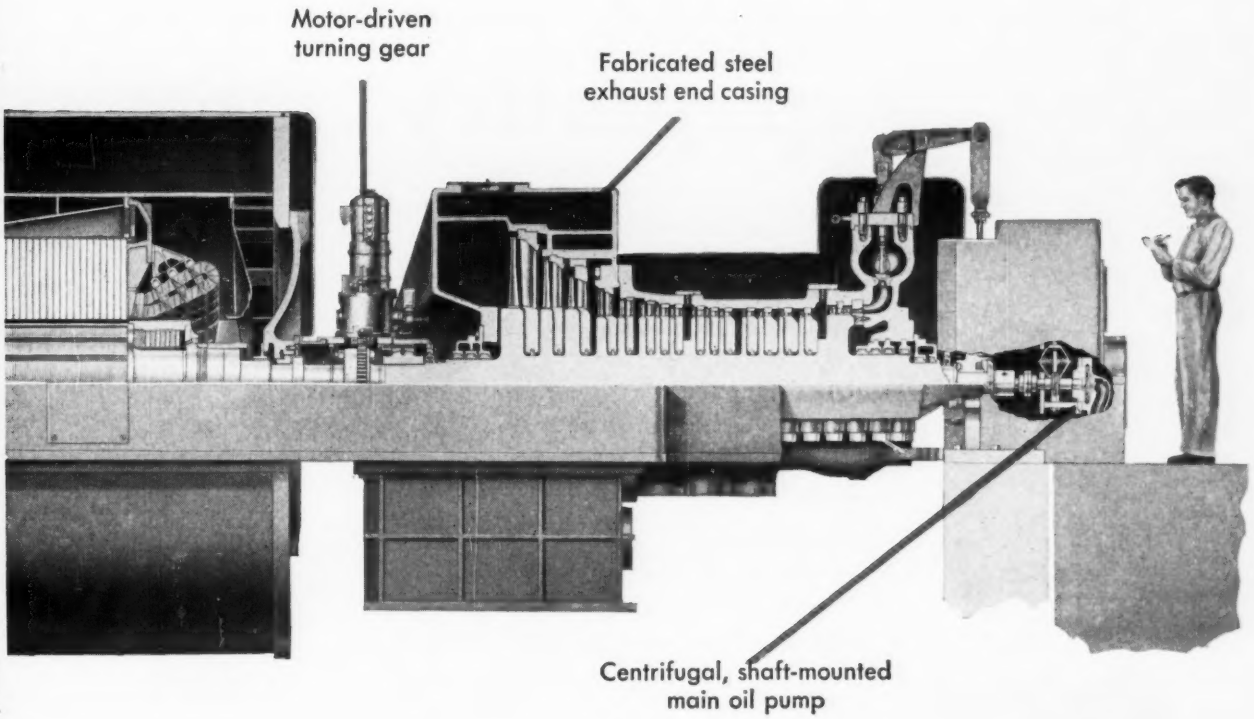
Simplified ● **Installation**

AIEE-ASME ● **and NEMA Ratings**

NEW WA-Series steam turbine-generator units now being manufactured include the 10,000-kw NEMA standard rating as well as 12,650-kw and 16,500-kw AIEE-ASME preferred standard condensing ratings. The 16,500-kw units have hydrogen-cooled generators.

Incorporated in the design are time-proved labyrinth steam sealing, removable external glands, high chrome alloy steel buckets and nozzles, reliable governing system, and unit shipment and installation — plus additional large turbine and generator features.

To get MORE information on economical, dependable units 2000 kw and larger, call the nearest A-C district office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.



CHALMERS

LIVE BETTER ELECTRICALLY

A-5127

use steam efficiently, economically—choose the trap with . . .

top quality...

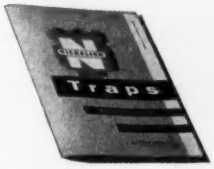
to keep it on the job

No need for a steam trap to be complicated. All it does is discharge condensate and air from steam lines and equipment. But its importance shouldn't be overlooked. On its effectiveness can rest your economical use of steam . . . the efficiency of your process operations.

A steam trap has to be built to serve long and dependably in severe service—and that's where Nicholson quality counts heavily in terms of performance.

- **One moving part**
- **Positive shutoff—no steam waste**
- **Powerful, intermittent valve action**
- **High capacity—effective use of large orifice**

Specify Nicholson, and be sure.



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Bulletin 10-55

NICHOLSON

W. H. NICHOLSON and Company

TRAPS • VALVES • FLOATS • METAL PARTITIONS
LAUNDRY, DRY CLEANING AND PRESSING MACHINERY

14 OREGON STREET, WILKES-BARRE, PA. • SALES AND ENGINEERING OFFICES IN 98 PRINCIPAL CITIES

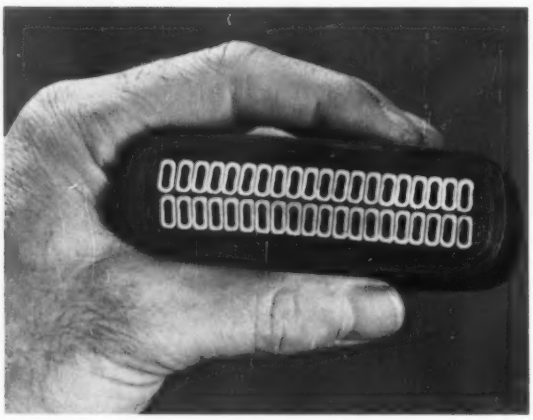
World's first large generator with liquid-cooled armature windings goes to Eastlake

New General Electric cooling system

...without appreciable

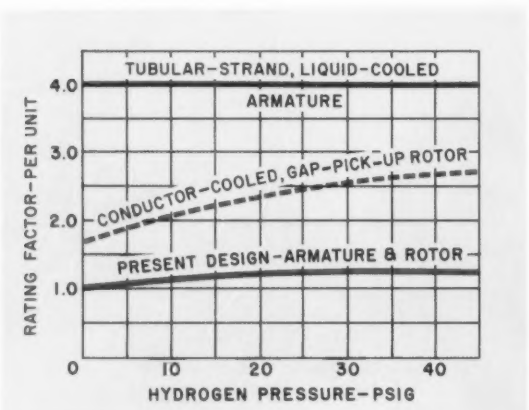
This evolutionary new 260,000-kva generator incorporates one of the most significant advances in generator cooling since General Electric pioneered hydrogen cooling in 1937. Now in operation at the Cleveland Electric Illuminating Company's Eastlake Plant, it is the world's first large generator with liquid-cooled armature windings. The liquid circulates right through the conductors.

THIS DESIGN IS THE MOST EFFECTIVE method of cooling yet developed. Combined with the new conductor-cooled, gap pick-up type rotor, a typical unit's rating may be doubled without appreciable increase in physical size.

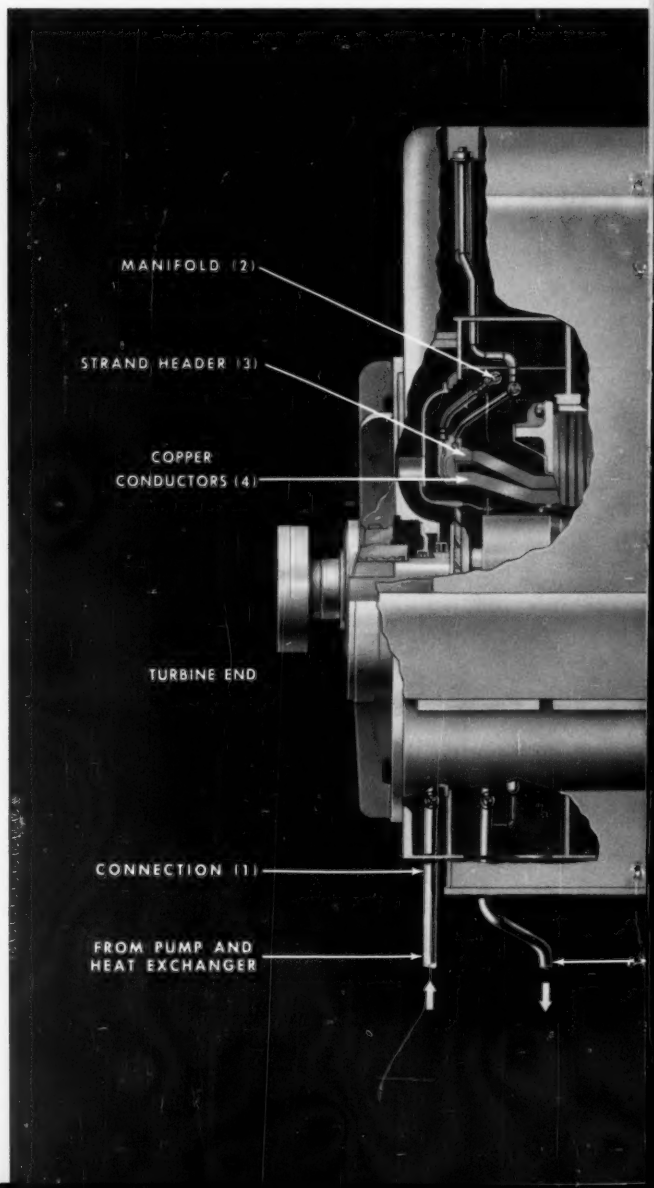


CROSS-SECTION OF ARMATURE BAR shows hollow tubular conductors which carry liquid coolant as well as current. Maximum heat removal is possible because of direct contact between cooling liquid and conductors.

COOLING LIQUID enters tubular conductors through strand header at end of armature bars. Cut-open section above shows how conductors are brazed to header.



HIGHER CAPACITIES are possible with new G-E conductor cooling development. Bringing liquid coolant in direct contact with the armature conductors can remove as much as sixteen times the heat that could be removed from them through the normal ground insulation with the same copper temperature.



can double generator rating

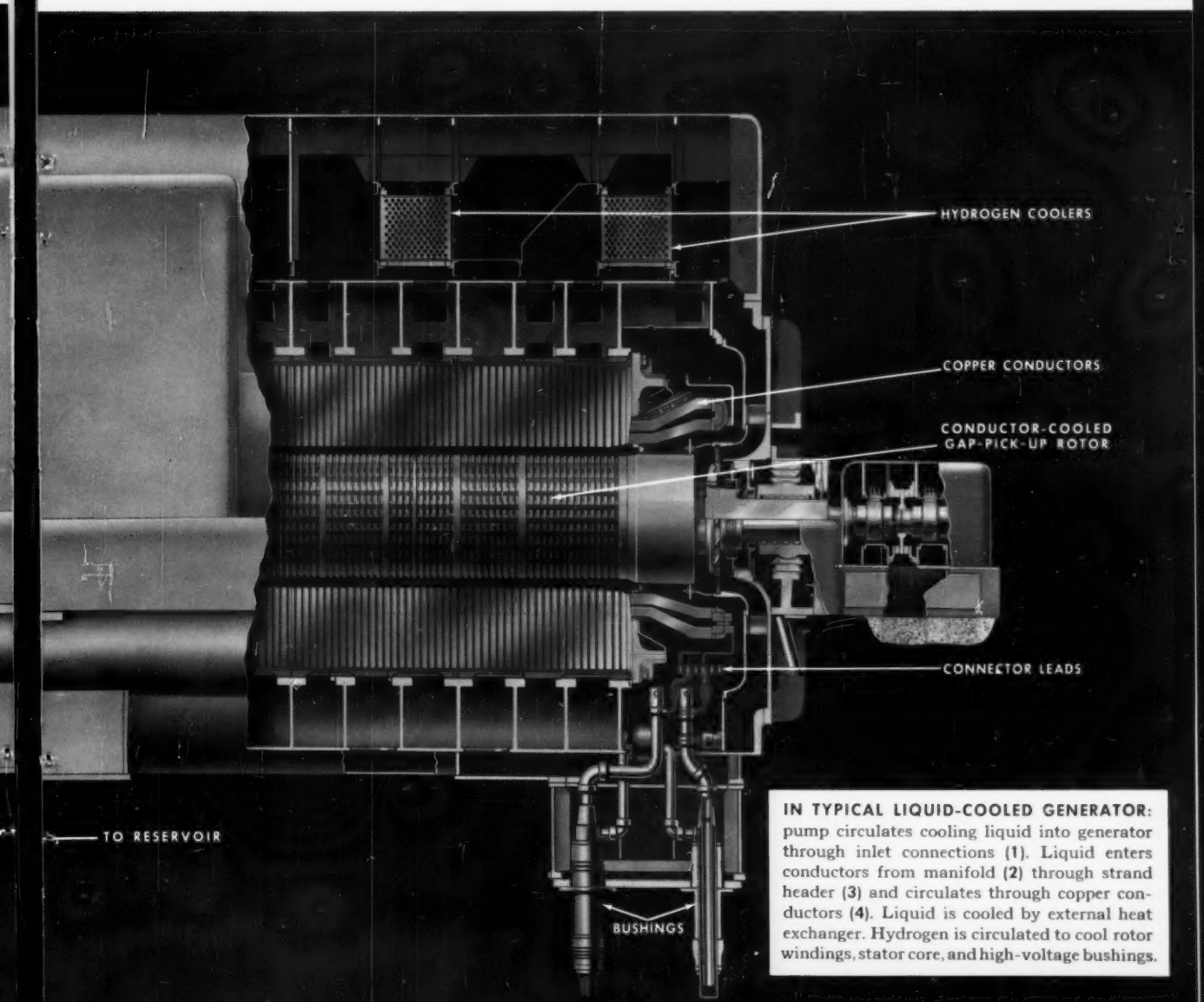
increase in physical size

Even with the increased current output made possible by liquid cooling, efficiency of this General Electric unit remains high. Design features such as: extra transposition of end windings; copper shields on the stator core clamping flanges; and machine dimensions specially designed to reduce windage losses, all contribute to this high efficiency.

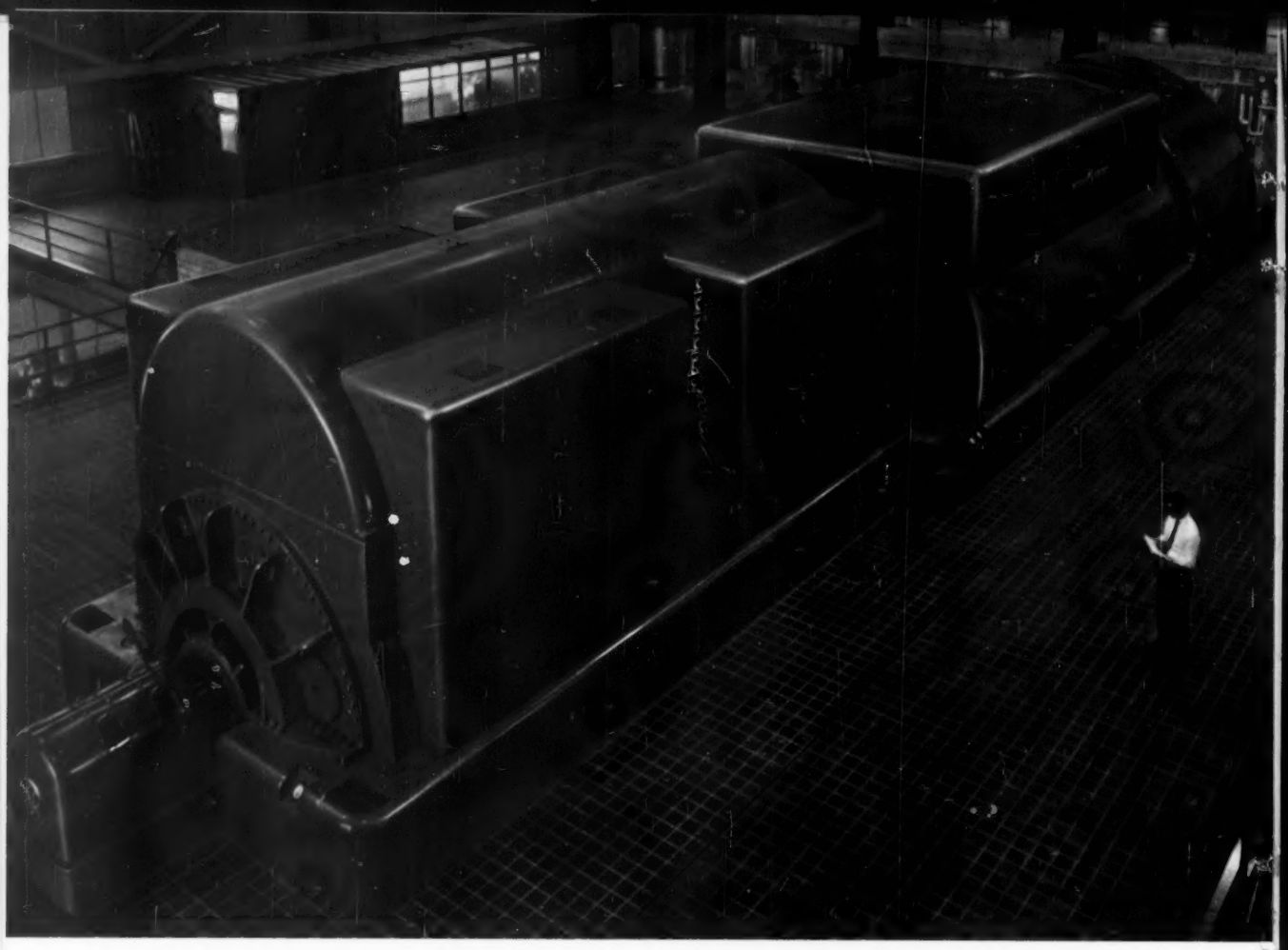
The coolant circulates in a double wall guarded circuit within the armature frame. A special brazed header provides permanent joining of tubular armature conductor strands. Both the liquid and the parts enclosing the coolant are carefully selected for noncorrosive characteristics.

This 260,000-kva, 30 PSIG Eastlake generator is the largest so rated 3600-rpm generator in the world. The new design developed for Eastlake is a significant step toward doubling generator ratings without appreciable increase in frame size and points the way to much larger machines—as high as 500,000-kva. For more information write for GER-1231, "Liquid Cooling of Turbine-Generator Armature Windings," Large Steam Turbine-Generator Department, General Electric Company, Schenectady 5, New York.

GENERAL ELECTRIC



IN TYPICAL LIQUID-COOLED GENERATOR: pump circulates cooling liquid into generator through inlet connections (1). Liquid enters conductors from manifold (2) through strand header (3) and circulates through copper conductors (4). Liquid is cooled by external heat exchanger. Hydrogen is circulated to cool rotor windings, stator core, and high-voltage bushings.



New generator produces 66% more power in same turbine room space

Eastlake's new General Electric conductor-cooled 260,000-kva generator (above) represents another milestone in turbine-generator progress. The new generator has increased station capacity 56% yet occupies the same turbine room space as each of the three other conventionally cooled, 156,250-kva General Electric units in this modern plant.

Obtaining more kilowatts in the same turbine room space is one of the many challenges created by the increasing expansion of electric utility loads. The Eastlake installation demonstrates how this challenge can be solved by advanced designs.

It is a typical example of how the electric utility industry and equipment manufacturers are cooperating to meet tomorrow's demand for larger blocks of power with turbine-generators of even higher ratings.

This latest expansion of the Eastlake plant is a further step in Cleveland Electric Illuminating Company's program of helping its customers to Live Better ... Electrically. 254-45

LIVE BETTER ELECTRICALLY

Progress Is Our Most Important Product

GENERAL ELECTRIC

ONE MORE REASON TO CHOOSE PRITCHARD COOLING TOWERS:

RUGGED *POWairSAVER** FAN DEVELOPS MAXIMUM AIR FLOW ECONOMICALLY

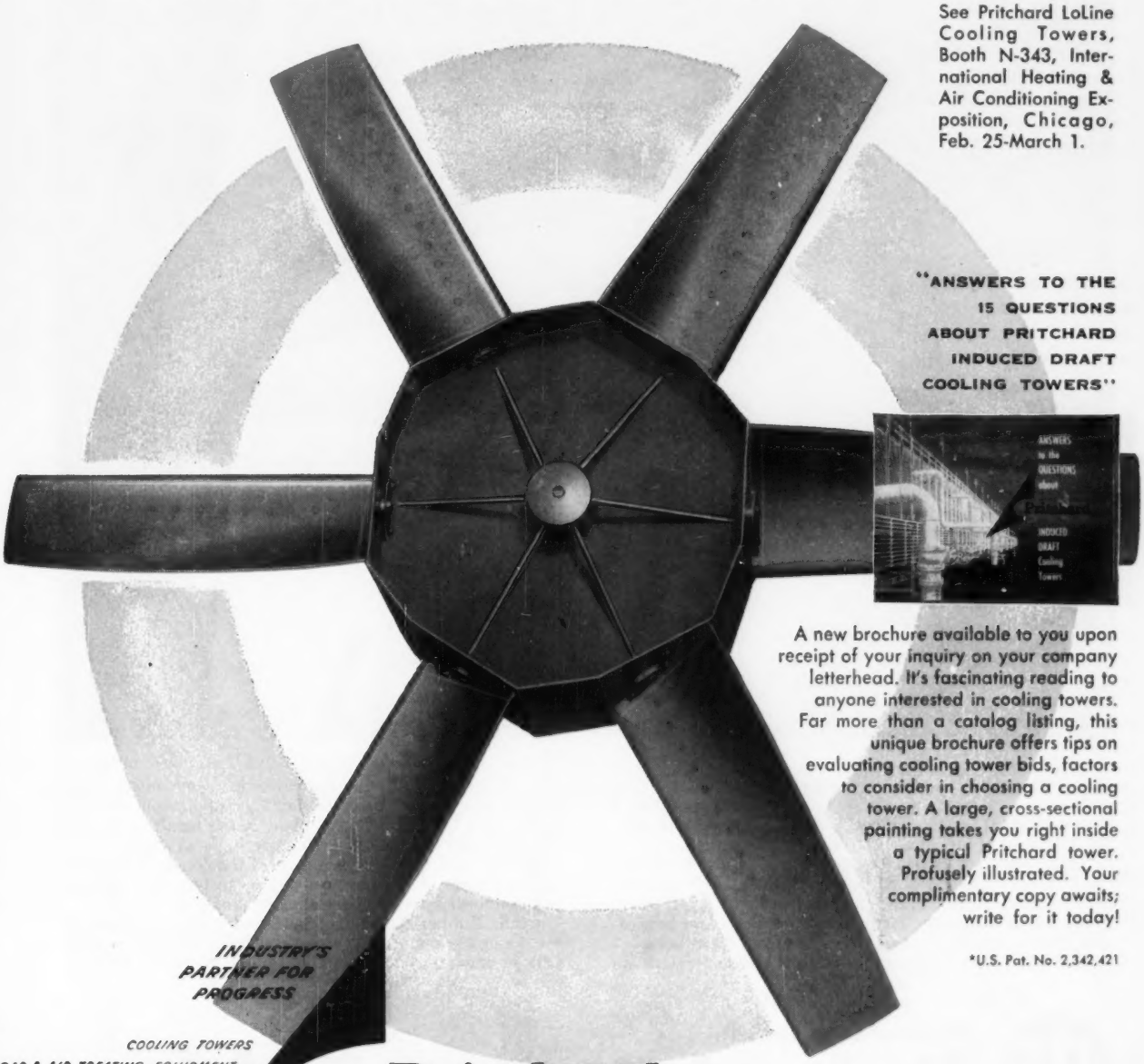
The POWairSAVER fan is exclusive with Pritchard. It was developed specifically for cooling tower service. It develops maximum air flow, economically, because of patented* design and construction.

The blade, of airfoil design, is twisted to pump as much air at the hub as at the tip of the blade. The hub is constructed to allow for no back flow of air near the hub. Thus, you get high aerodynamic efficiency, with low horsepower, on this adjustable pitch, POWairSAVER fan, exclusive with Pritchard!

POWairSAVER blades and hubs are precision-made in jigs for greater uniformity and easy interchange of parts. Monel or stainless steel blades are available to meet specific anti-corrosion requirements.

A six-blade design is pictured. Also available in four and eight-blades. It's exclusive with Pritchard—the POWairSAVER fan—one more reason to choose Pritchard cooling towers!

See Pritchard LoLine Cooling Towers, Booth N-343, International Heating & Air Conditioning Exposition, Chicago, Feb. 25-March 1.



"ANSWERS TO THE 15 QUESTIONS ABOUT PRITCHARD INDUCED DRAFT COOLING TOWERS"

A new brochure available to you upon receipt of your inquiry on your company letterhead. It's fascinating reading to anyone interested in cooling towers. Far more than a catalog listing, this unique brochure offers tips on evaluating cooling tower bids, factors to consider in choosing a cooling tower. A large, cross-sectional painting takes you right inside a typical Pritchard tower. Profusely illustrated. Your complimentary copy awaits; write for it today!

*U.S. Pat. No. 2,342,421

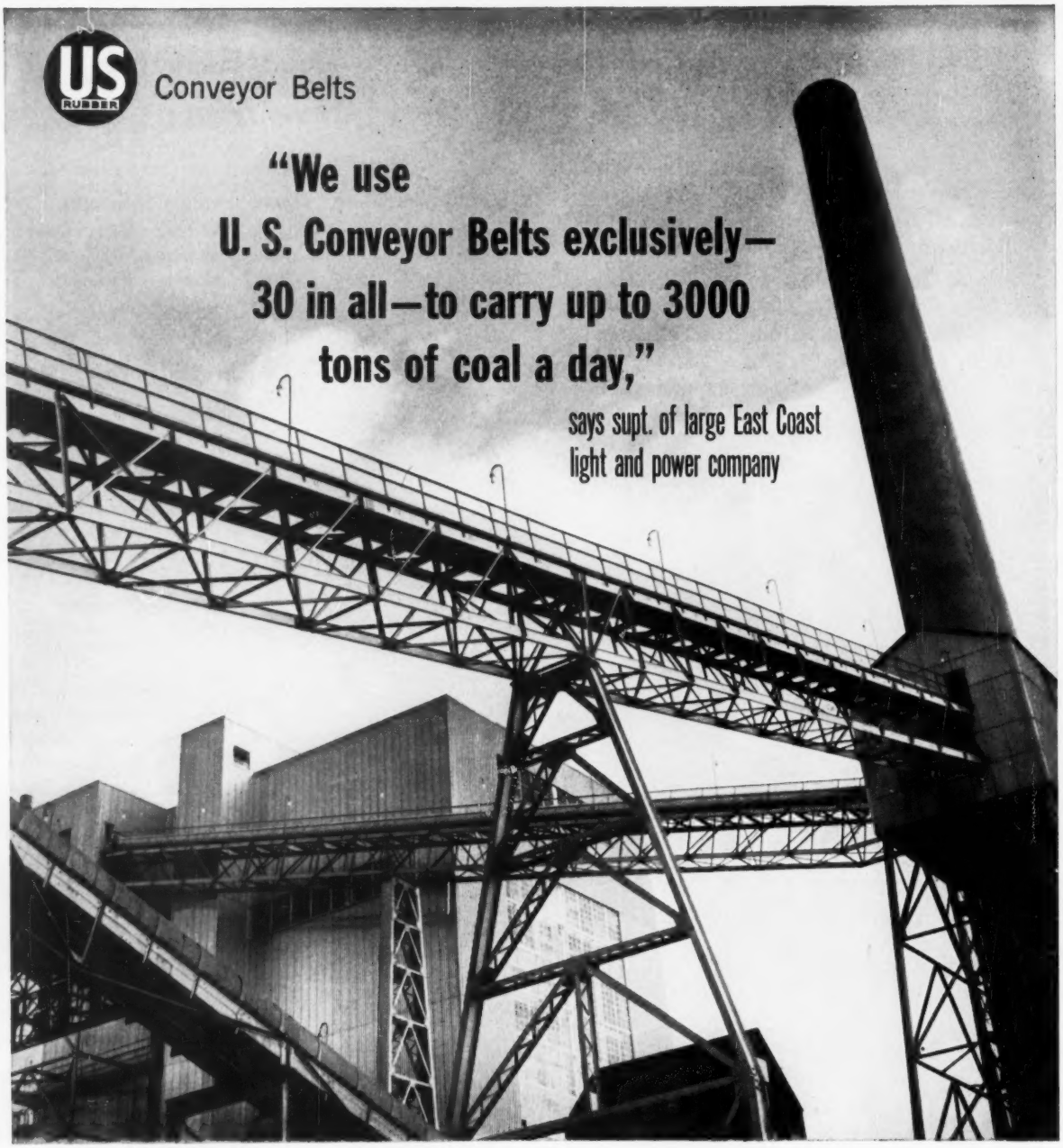
INDUSTRY'S PARTNER FOR PROGRESS

COOLING TOWERS
GAS & AIR TREATING EQUIPMENT

REPRESENTATIVES IN PRINCIPAL CITIES FROM COAST TO COAST

J.F. Pritchard & Co.
OF CALIFORNIA
A DIVISION OF J. F. PRITCHARD & CO.

Dept. 494, 4625 Roanoke Parkway, Kansas City 12, Mo.


US RUBBER
Conveyor Belts
"We use
U. S. Conveyor Belts exclusively—
30 in all—to carry up to 3000
tons of coal a day,"
says supt. of large East Coast
light and power company

The giant generating plant of this large New England light and power company, furnishes enough electric power for a city of 165,000 people. Thirty "U.S." Conveyor belts carry the 3000 tons of fuel in a round-the-clock operation.

"Our needs are constantly expanding," says the super, "and we intend to use 'U.S.' belts exclusively. Belting is the best way to carry coal . . . and the best belting is U.S. Rubber. Maintenance is usually confined to inspection and lubrication. We expect many years of service from these belts."

That's the story everywhere. High-volume operators are using "U.S." Belting, and the result is always *lower costs.* Like so many other successful belting installations, the system in this light and power plant is the result of United States Rubber's "Three-Way Engineering"—in which "U.S." engineers work with the engineers of the conveyor builders and engineers of the power company to turn out the best belt conveyor system for the specific job.

U. S. Rubber Conveyor Belts and expert engineering assistance are available at any of the 28 "U.S." District Sales Offices, or write us at Rockefeller Center, New York 20, N.Y.

US RUBBER
Mechanical Goods Division
United States Rubber

WE SPECIALIZE IN BRONZE VALVES

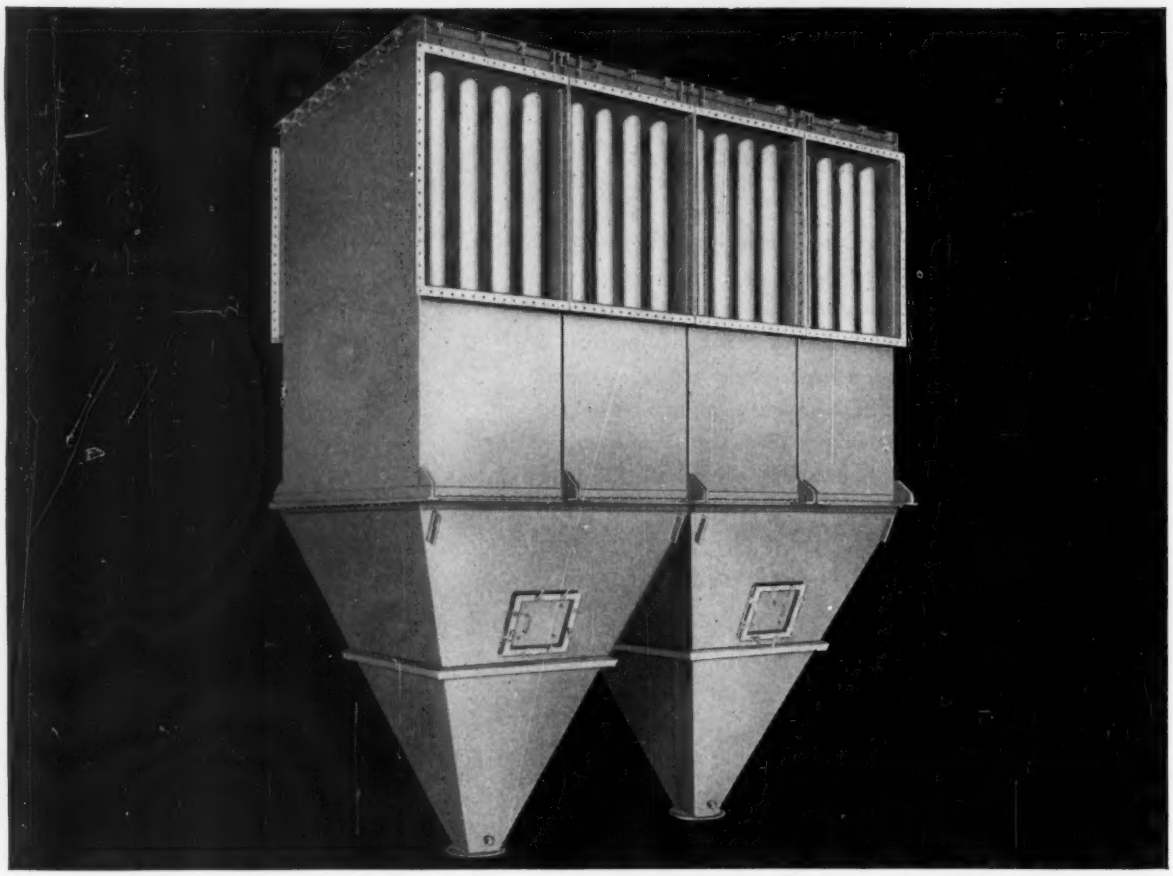
Ohio Brass has specialized in manufacture of bronze valves since shortly after the company was founded in 1888. You go to a specialist for other products and services. Why not buy bronze valves from a company that has made a specialty of producing them? In many plants O-B bronze valves have helped reduce maintenance time. O-B bronze valves are competitively priced. Ask your distributor about them.

OHIO BRASS • MANSFIELD, OHIO, U.S.A.

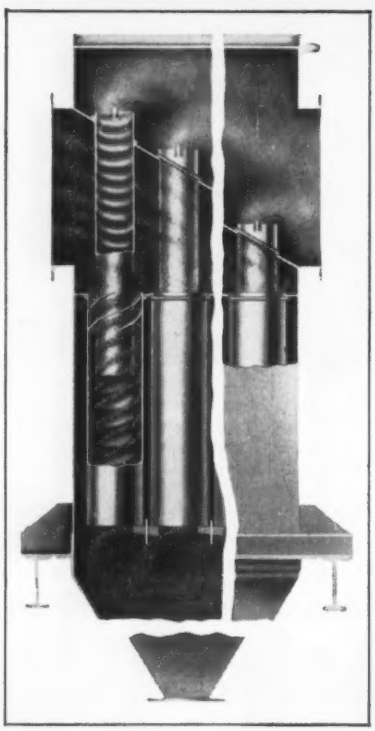
4618-V

O-B VALVES

Control fly ash with job-fitted



Series 342 Precipitator



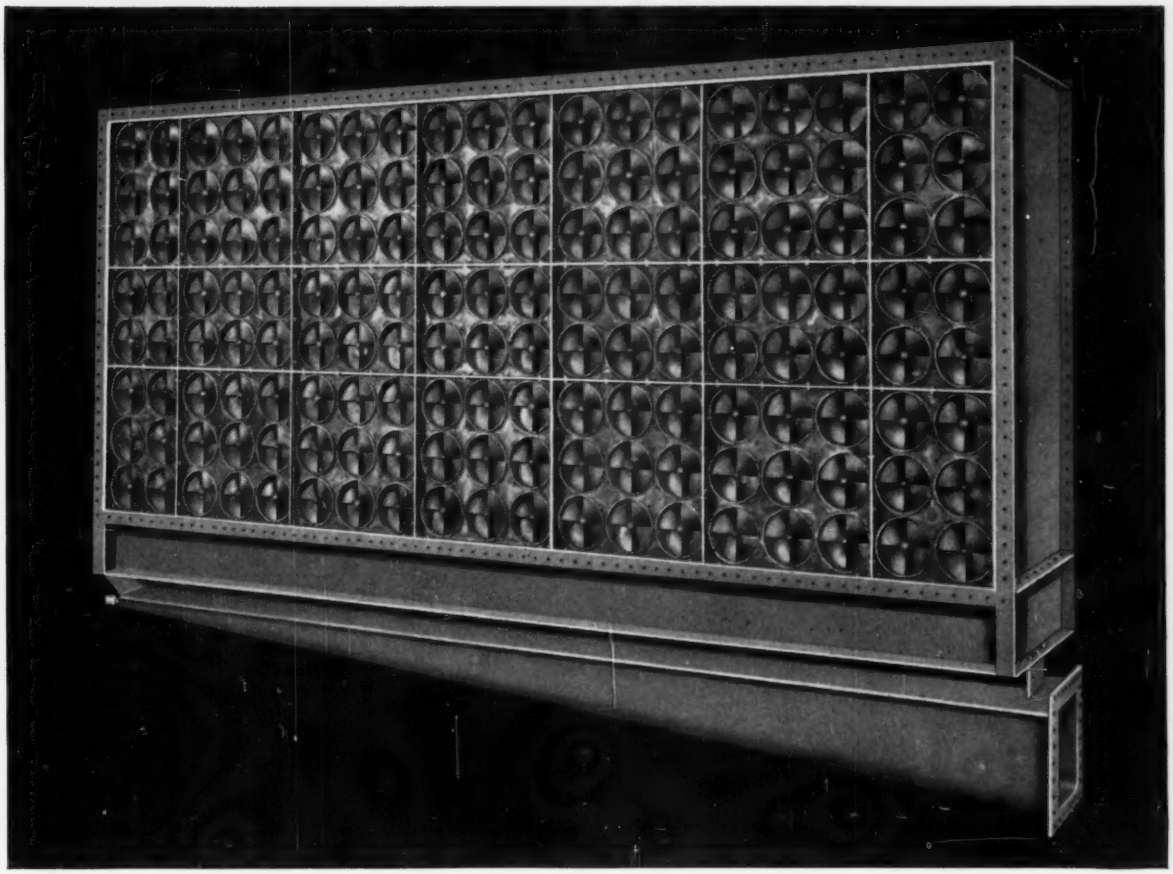
COMPACT DUST COLLECTOR – Series 342 Precipitator meets industry's need for a simple, compact, economical, all-purpose, mechanical-type dust collector. With the growing value of fly ash as a salable by-product, adequate, efficient collection is becoming increasingly important.

Easy to install because of its sectionalized construction, the Series 342 Precipitator has proved effective in controlling dust discharge to the atmosphere in a large percentage of industrial plants. The reason: since each tube assembly is basically an individual cyclone or centrifugal dust collector, the multi-tube Series 342 will deliver an over-all performance comparable to the high efficiency obtained by a single, small-diameter cyclone.

Furthermore, American Blower Series 342 Precipitator features welded-steel construction and removable tubes, is available in a variety of sizes to meet specific job requirements on either new or existing installations.

Dust-laden air or gas enters inlet plenum; gravity and centrifugal action force dust downward, adjacent to tube wall; dust is skimmed into gas-tight receptacle; cleaned air or gas moves upward through outlet tubes to outlet plenum.

American Blower precipitators

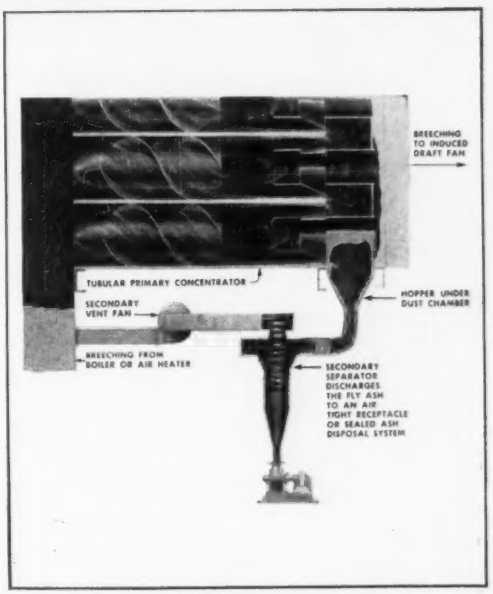


Series 361 Fly Ash Precipitator

FOR LARGE PUBLIC UTILITIES – Series 361 Fly Ash Precipitator offers maximum collection efficiency over entire operating range, occupies minimum space, and gives reliable performance, trouble-free operation.

What's more, the secondary separating system of the Series 361 makes it relatively more efficient at reduced loads when fly ash is finer and more difficult to remove. Then, too, ability to vary number and arrangement of individual cells makes it easy to tailor unit to the particular job.

Whatever your dust-collection problem, it will pay you to talk to an American Blower engineer. His knowledge of the application of precipitators and dust collectors can prove invaluable to you. Call your nearest branch, or write: American Blower Corporation, Detroit 32, Michigan. In Canada: Canadian Sirocco products.


BREECHING TO INDUCED DRAFT FAN
TUBULAR PRIMARY CONCENTRATOR
SECONDARY VENT FAN
HOPPER UNDER DUST CHAMBER
BREECHING FROM BOILER OR AIR HEATER
SECONDARY SEPARATOR DISCHARGES THE FLY ASH TO AN AIR TIGHT RECEPTACLE OR SEALED ASH DISPOSAL SYSTEM

Secondary system results in velocity-efficiency characteristics which automatically maintain maximum efficiency over entire boiler load or operating range. Properly installed and operated, unit's collection efficiency is from 85% to 90%.

AMERICAN BLOWER

Division of AMERICAN-Standard

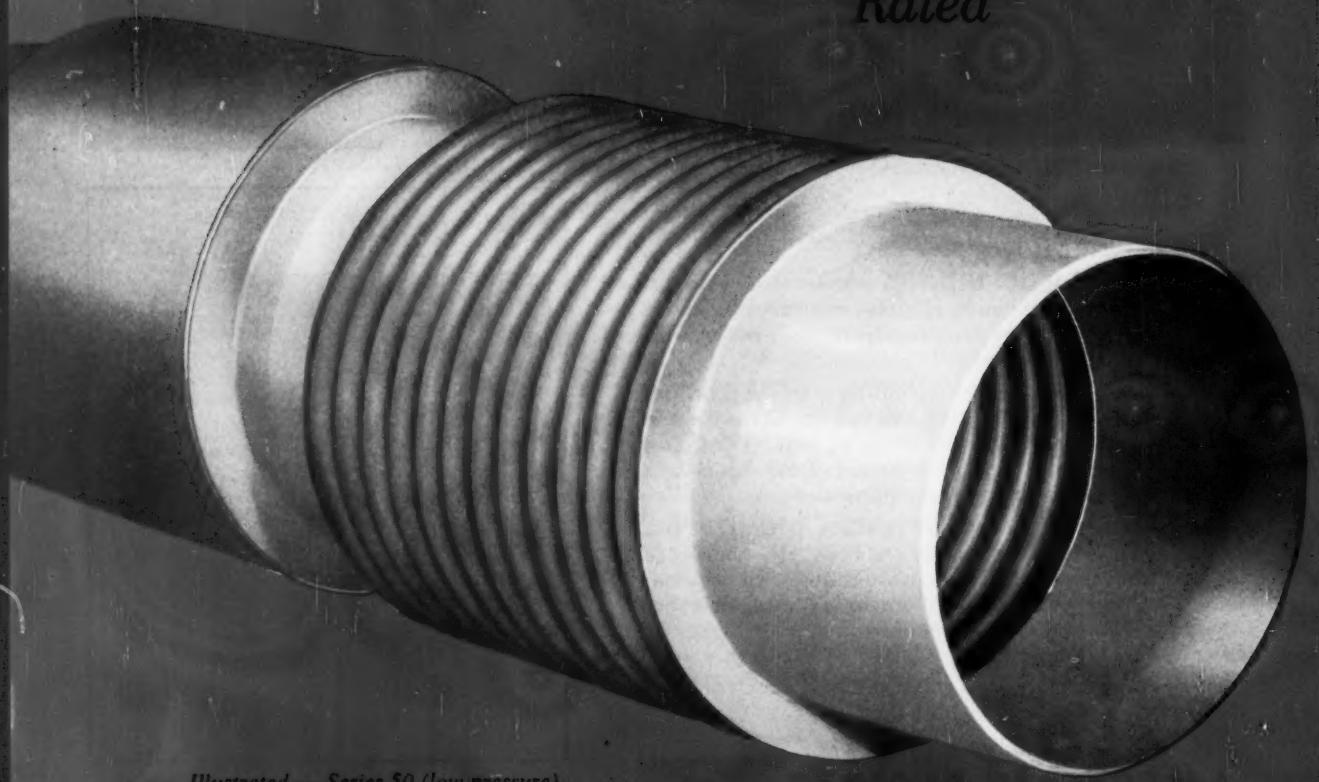
a **NEW DESIGN** from the world's

BADGER

S•R*

EXPANSION JOINTS

* *Service-Rated*



Illustrated — Series 50 (low pressure) S-R Double Joint with welding ends. Cover removed from one bellows.

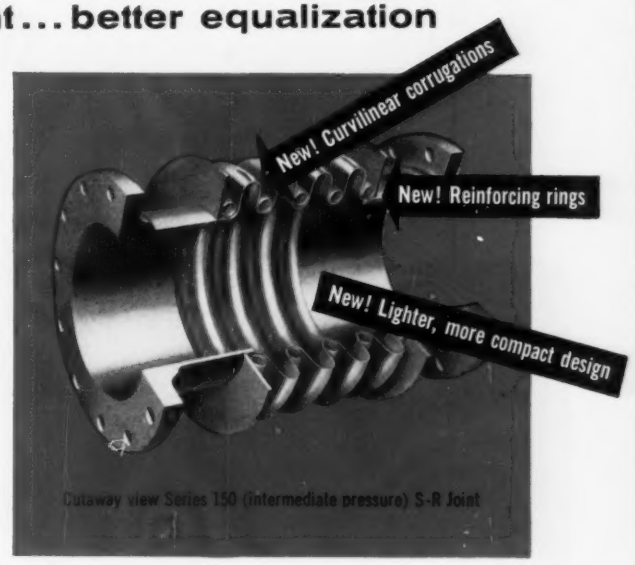
most experienced manufacturer

Revolutionary new design provides longer cyclic life... less weight... better equalization

Over three years of intensive research and testing have paid off! Badger S-R Expansion Joints — corrugated packless expansion joints of an entirely new design — are ready for your most exacting power, heating, industrial and process piping applications.

Two significant features of the new joints are 1.) Curvilinear Corrugations, which result in natural "all-curve" flexing and equal distribution of movement among the corrugations; 2.) tubular Reinforcing Rings, which work with the new corrugations to produce greater effective flexing height and "all-curve" flexing even under higher pressures and temperatures.

And there are other important features, too . . . size for size, Badger S-R Joints weigh up to 50% less than conventional types . . . new ring design reduces joint diameter . . . a complete line of accessories — including covers and liners — are available . . . standard models in stainless, monel and inconel, special types in any workable alloy.



Cutaway view Series 150 (intermediate pressure) S-R Joint

New corrugation and ring designs produce better equalization, "all-curve" flexing

Series 50 (low pressure) S-R Expansion Joints

The radically different Curvilinear Corrugations used in Badger S-R Expansion Joints were developed by the Badger Research Department. As shown in the cross-section of a Series 50 Joint (left), the design produces more uniform movement per corrugation and flexing to a natural "all-curve" shape, which results in lower stresses and therefore increased life. (White line in diagram shows the efficient "all-curve" shape the corrugations *naturally* assume under operating pressures.)

Series 150 (intermediate pressure) S-R Expansion Joints

Series 150 S-R Joints feature Curvilinear Corrugations and, because they are used at higher pressures, also have tubular Reinforcing Rings. A significant engineering improvement, these new rings make metal-to-metal contact only in the "valley" of each corrugation yet allow natural "all-curve" flexing (white line) when the pipeline is subjected to pressure. The tubular shape of the rings also permits greater effective flexing height and therefore contributes to longer joint life.

Learn more about ways S-R Joints can be of advantage to you . . .

New illustrated brochure describes them in detail — mail coupon for your free copy today.

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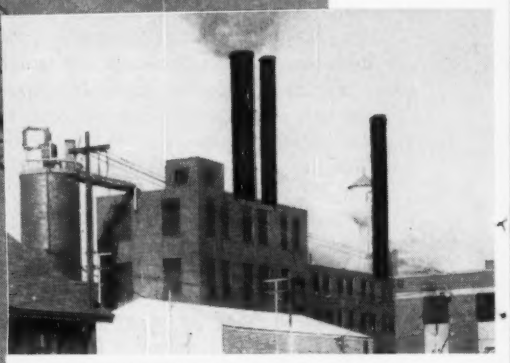
August 1955 *painter discovers dangerous corrosion in seven-year-old stack*

Prominent to corrosion-protected



Oscar Mayer Permaglas stacks measure 7′-6″ I.D. by ¼″ by 59′-6″ and 5′-0″ I.D. by ¼″ by 77′-6″. Larger stack (extreme left) handles approximately 182,000 lbs. per hr. of flue gas at 14.5% CO_2 at rated boiler load. Smaller stacks handle 149,000 lbs. of flue gas per hour at rated load.

FAST, EASY INSTALLATION—only precautions normally taken are use of pads under each sling, or sections can be easily erected using standard lifting fixtures. Permaglas sections are bolted together — no welding is required in the field.

Permaglas glass-protection gives you:

- 3 to 5 times longer life
- corrosion resistance regardless of excess condensate
- low maintenance — glass can't rust
- lightweight—lower foundation cost
- lower cost — glass protection now within reach of all
- tough, durable — remarkable resistance to impact or abrasion
- easy to install — no need for special equipment or highly skilled workmen

meat packer converts plant 100%

Permaglas® smokestacks

Glass-protected steel stands off corrosive acid action over 3 times longer than unlined steel smokestacks

OSCAR MAYER & CO., MADISON, WIS., took immediate action and converted to Permaglas smokestacks when they discovered a dangerous corrosion condition in two plain steel stacks.

In their seven-year-old stack, the area above the lower flange of the top section was corroded to breakthrough for about one-half its circumference. The remaining half was about 1/10-in. thick. *Original thickness had been 1/4 in.* The top one-third of the stack was removed immediately for safety purposes. Investigation indicated metal thickness of 1/8 in. at the bottom of the center section and less than 3/16 in. at the base of the stack.

A small fifteen-year-old stack was similarly corroded by acid action of flue gas condensing out at low stack temperatures.

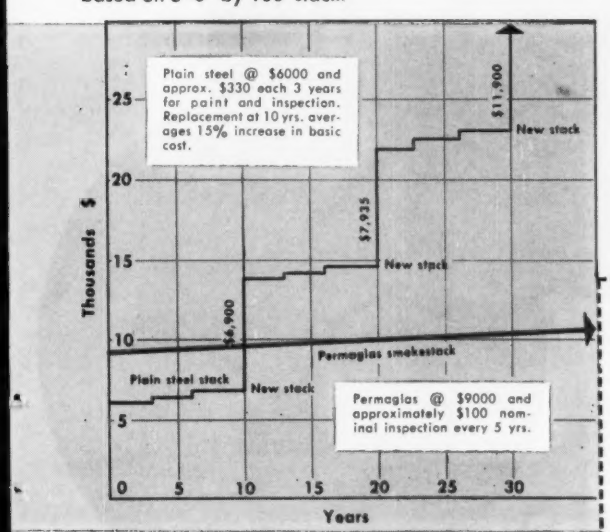
Recent installation of a third Permaglas stack, gives Oscar Mayer's Madison plant 100% protection against smokestack corrosion.

Why wait until trouble strikes? Why let corrosion cost you money? Surveys show that about 95% of all steel smokestack failures are caused by corrosion *inside* the stack. Stop this needless waste by converting to Permaglas smokestacks with exclusive glass protection *inside* and *out*. Contact your nearest A. O. Smith representative or write today giving details of your present stack problems or needs.

Visit our booth 1826 at Plant Maintenance & Engineering Show — Cleveland Public Auditorium, Jan. 28-31, 1957.

A number of Permaglas Smokestack Sales Territories are currently available. Write for details.

Permaglas savings analysis — cost approximations based on 5'-0" by 100' stack.



Over three times longer service — Based on figures furnished by plain, carbon-steel stack users. The economy of Permaglas stacks is demonstrated in the above chart.

Through research A.O. Smith *... a better way*

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CORPORATION

PROCESS EQUIPMENT DIVISION
PERMAGLAS SMOKESTACK SALES
MILWAUKEE 1, WISCONSIN

A. O. Smith Corporation, Dept. P-17
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Please send me a copy of the NEW Permaglas Smokestack Bulletin No. MS-221.

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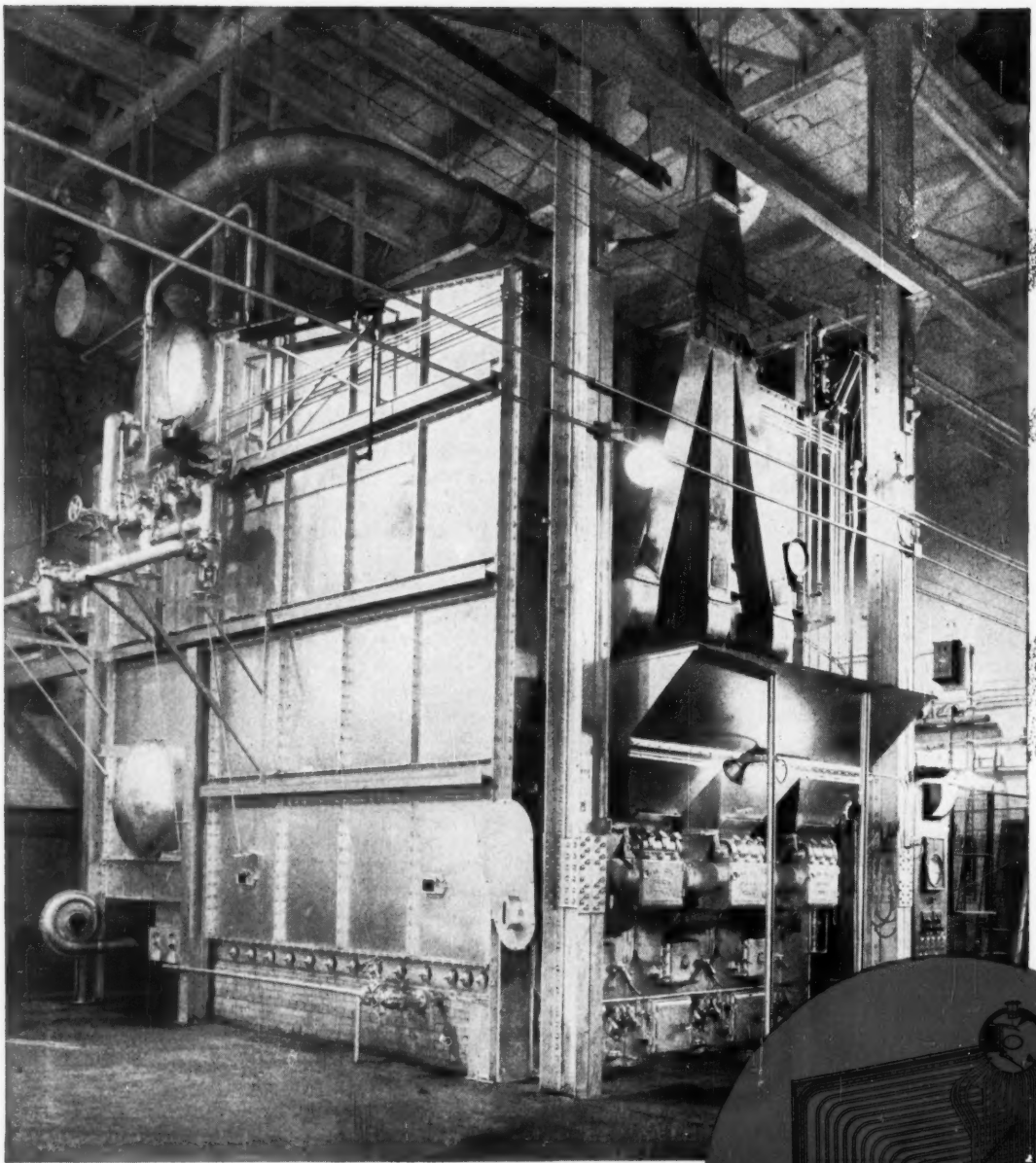
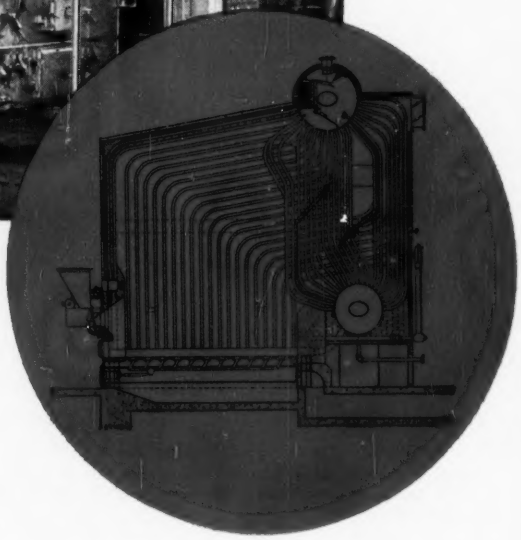
ERIE CITY~





Data

Boiler	Erie City 4 VC
Capacity	35,000 lbs./hr.
Operating Pressure	250 lbs.
Stoker	Erie City Dump Grate Spreader

~STEAM GENERATOR at the BRUNSWICK-BALKE-COLLENDER COMPANY

Burns Coal + Wood Waste•••

• Another major industrial concern, Brunswick-Balke-Collender Company of Muskegon, Michigan, has turned to Erie City Iron Works to satisfy its steam needs. Brunswick required a 35,000 lbs./hr. boiler, fired with coal, and having a properly designed furnace to burn their constant accumulation of wood waste. To satisfy these requirements, Erie City engineers used a standard 4-VC Boiler and a triple feeder dump grate spreader stoker.

The furnace was specifically designed to burn the coal that was most economically available and with sufficient furnace volume to burn the wood waste. The boiler proper is designed with drainable baffles and reinjection system to return any unburned particles of wood or coal to the furnace. The VC unit was selected for its compact design and low installation cost. The complete water cooled furnace eliminates the necessity of heavy refractory walls and thereby reduces maintenance costs.

This installation at Brunswick-Balke-Collender is another fine example of how Erie City engineers can adapt standard products to suit particular requirements.

For additional information on Erie City VC boilers or spreader stokers, contact your local Erie City Agent or write for bulletins VC 2A and SB 422A.

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117 Years in Steam Generation

You can depend on Erie City for sound engineering

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

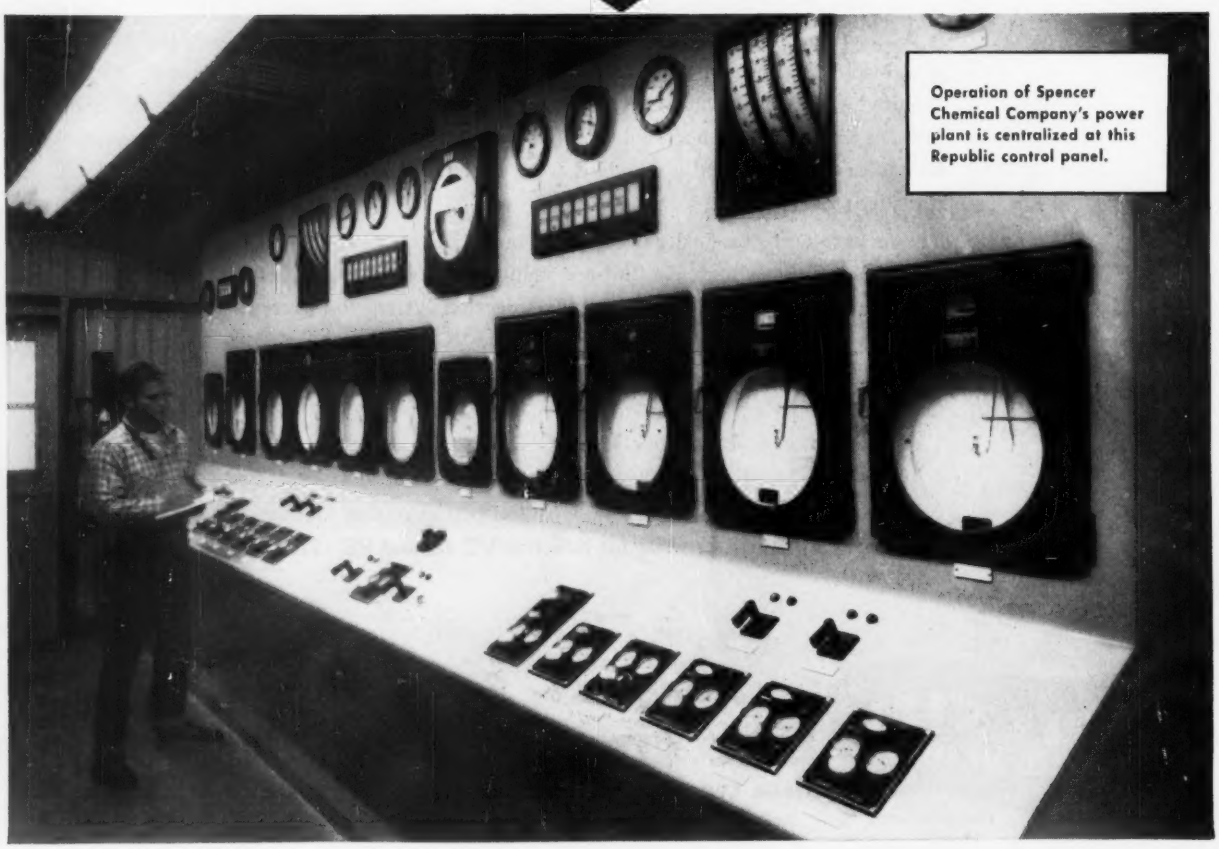
Automatically Controls Outdoor Steam Plant

FOR FAST LOAD CHANGES

REPUBLIC Combustion Control System at New Texas Chemical Plant Automatically Prevents Flame-Outs and Over-Firing on Wide Load Swings, Enables Boilers to Meet Sudden Steam Demands Smoothly and Safely

Extremely large and fast load changes make combustion efficiency only part of the combustion control job at Spencer Chemical Company's new Orange Texas polyethylene plant. The control system operates two gas fired 60,000 lbs. per hour boilers in the plant for fast response to load changes without over-firing or losing ignition on wide load swings.

To prevent over-firing when there is a sudden demand for more steam, a gas



Operation of Spencer Chemical Company's power plant is centralized at this Republic control panel.

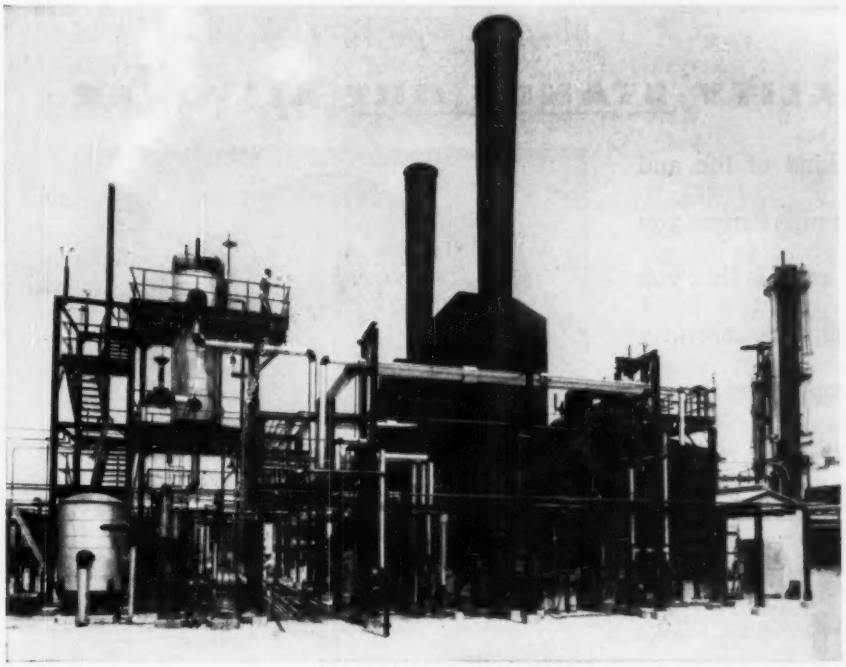
safety regulator keeps the fuel valve in step as draft fans increase speed. By compensating for the unequal speed of response of the two boiler auxiliaries, the control system maintains proper conditions *even while loads are changing.* If steam demand falls below minimum steam conditions, a minimum gas pressure is maintained automatically at the burners, regardless of the number in service, to prevent flame-outs. In addition to safer operation, these features also mean continuous combustion efficiency for extra fuel savings.

When your problem is combustion control—for a small power plant or a central station—it will pay you to contact Republic. At your service is an experienced engineering staff that can design the control system that exactly meets your needs—specialized as they may be. This combination of expert design and modern Republic equipment can assure you of dependable, efficient control of your power plant.

REPUBLIC
Automatic COMBUSTION CONTROLS
(pneumatic or electronic)

- ★ **FOR ALL SIZES AND TYPES OF BOILERS**
- ★ **FOR ALL LOAD CONDITIONS**
- ★ **FOR ALL METHODS OF FUEL FIRING**
- ★ **FOR ANY ARRANGEMENT OF DRAFT**

Write for details



THE ENTIRE POWER PLANT,

except for the control panel is outdoors. Panel board is housed in sheet metal building at right. The two 60,000 lbs. per hour gas fired boilers, operating at 415 psi and 750°F., furnish steam to compressors used in converting ethylene gas into polyethylene. This is new miracle plastic that is used for products ranging from "squeeze" bottles to electrical insulation.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

PHOENIX QUALITY STANDS OUT ALL OVER

We needn't tell you what kind of life and service you demand from the pipe flanges you buy. The important thing to know is that you are ordering flanges which will be consistently high in quality. Phoenix drop-forged flanges *always* meet the highest quality and strength specifications. No one makes a better flange!

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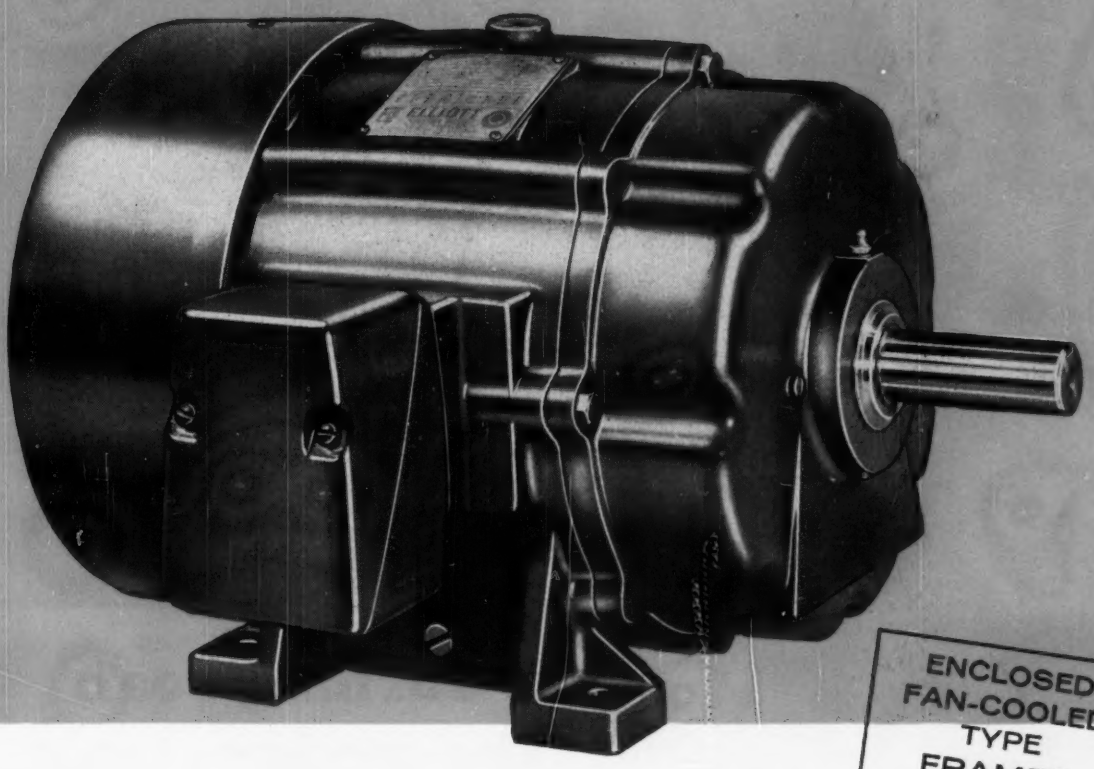
Integrated Manufacturing Facilities: FLANGE AND FORGING DIVISION, STEEL BAR MILL DIVISION, RUBBER PRODUCTS DIVISION AND HORSESHOE PRODUCTS DIVISION

Inside and Outside . . . entirely new



ENCLOSED FAN-COOLED TYPE FRAMES 184-256U

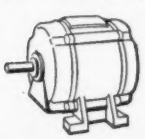
Elliott C-W Type N Motors

NEW PERFORMANCE! You get more horsepower per pound from these compact Elliott C-W motors because of their improved design, and the use of vastly superior insulating materials and electrical steels. Due to greater mechanical and dielectric strength, insulating materials occupy less space. More space is available for copper—the "muscle" of the motor.

NEW PROTECTION! Internal parts of Elliott C-W motors are completely protected by rugged housings—dripproof, or totally-enclosed, as required. Efficient fans assure ample cooling.

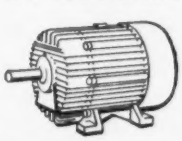
NEW DEPENDABILITY! New Elliott C-W type N motors are designed for the utmost in dependability. They will withstand physical abuse. Use of highly dependable insulating materials assures prolonged life; anti-friction bearings are available in several optional types, to meet severe service conditions.

OTHER C-W TYPE N MOTOR ENCLOSURES



Totally-enclosed non-ventilated

Dripproof Protected

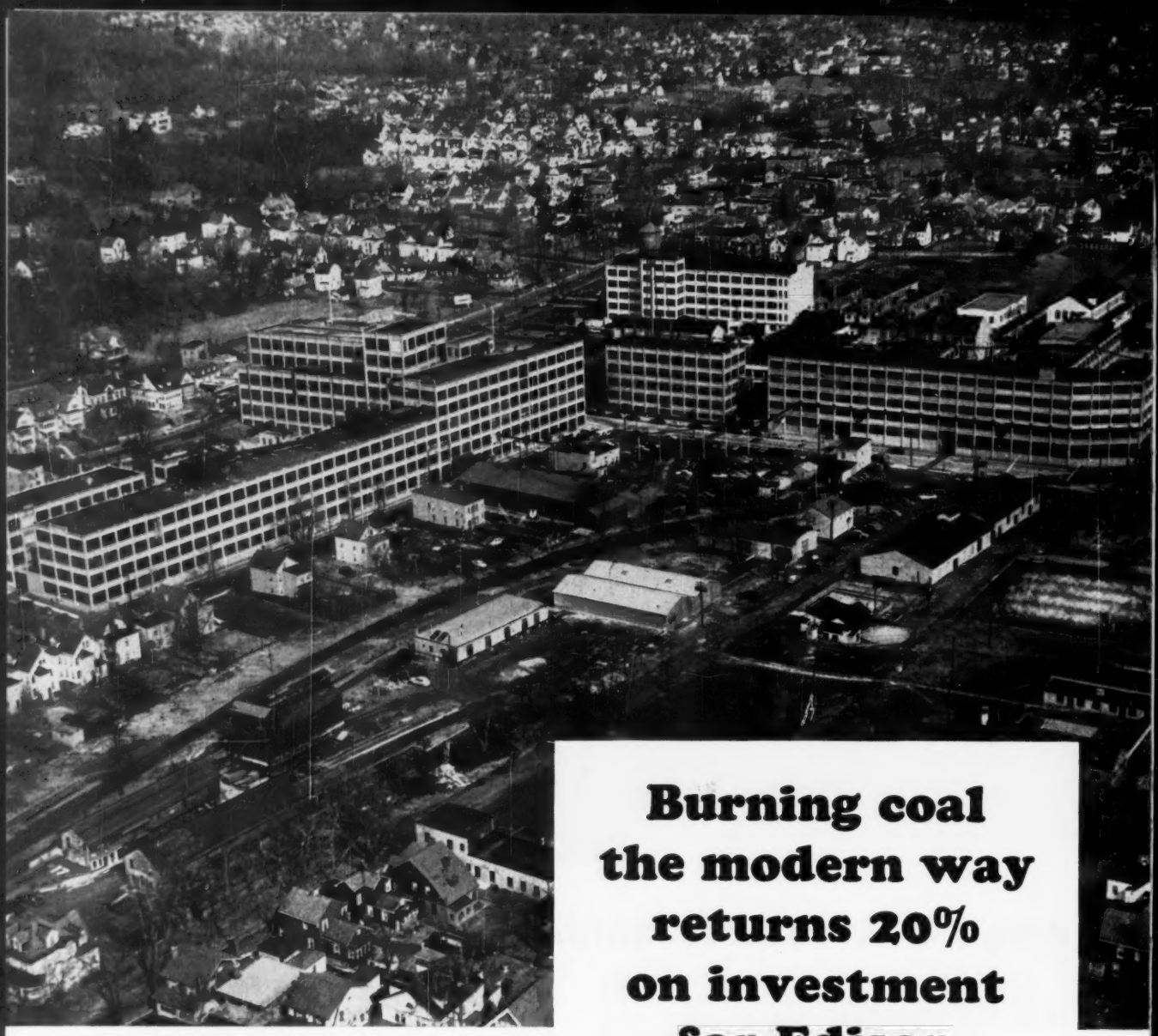


Totally-enclosed, fan-cooled (ribbed frame)

ELLIOTT Company

CROCKER-WHEELER DIVISION

WRITE for new bulletin describing Elliott C-W Type N Motors. Address: Elliott Company, Crocker-Wheeler Division, Jeannette, Pa.



Burning coal the modern way returns 20% on investment for Edison

Consult an engineering firm

Designing and building hundreds of heating and power installations a year, qualified engineering firms can bring you the latest knowledge of fuel costs and equipment. If you are planning the construction of new heating or power facilities—or the remodeling of an existing installation—one of these concerns will work closely with your own engineering department to effect substantial savings not only in efficiency but in fuel economy over the years.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum. Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

The firm of Thomas A. Edison, Inc., West Orange, N. J., was faced with a common problem—rising steam plant costs. A thorough survey indicated the need for modernization of the power system. As a result, six 30-year old boilers were replaced with two 60,000 lb./hr. units. FD and ID fans, pneumatic ash systems, coal pulverizers and related equipment were installed.

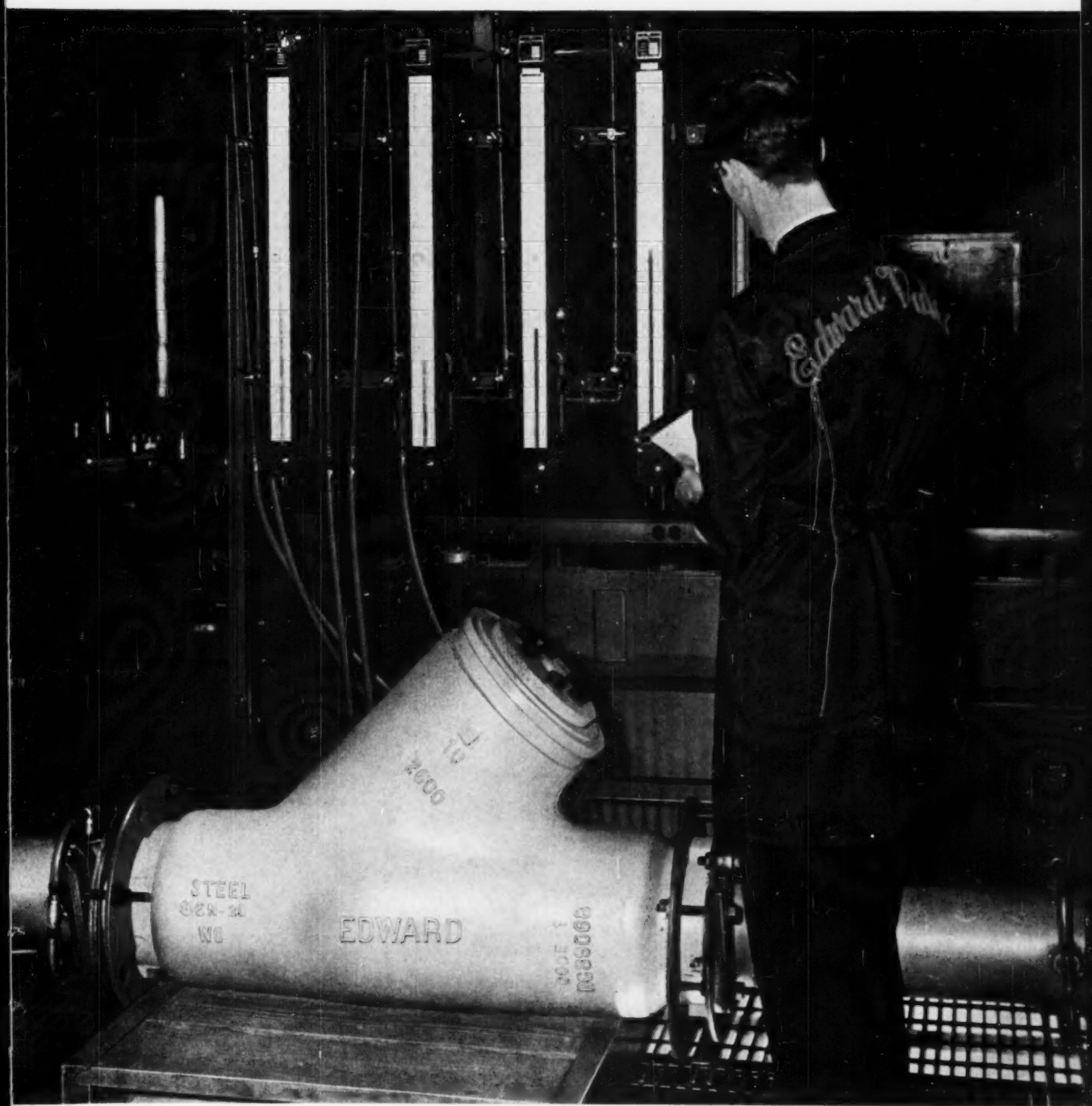
Modernization has paid off at Edison! Steam-generating capacity per sq. ft. of boiler room space has been doubled, labor costs have been cut, fuel costs are down, boiler efficiency is up 16% and modernization gives a 20% annual return on a net investment of 2.7 mils per BTU!

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

BITUMINOUS COAL INSTITUTE
Southern Building • Washington 5, D. C.

Edward valve values

Edward Valves, Inc. Subsidiary of ROCKWELL MANUFACTURING COMPANY
EAST CHICAGO, INDIANA



Radically improved globe valve shape cuts best previous globe valve pressure drop 70%

EDWARD VALVE VALUES

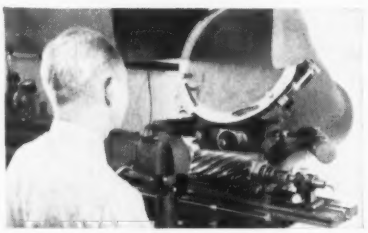
"Gaging" a Gage

Precision equipment allows Edward inspectors to measure within millionths of an inch.

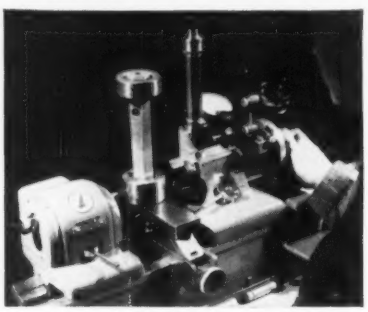
"This is too much of a rush job to send my gages to Washington for checking," an East Chicago manufacturer complained when he called Edward to borrow gages and was told the Bureau of Standards would check them for him.

He didn't realize the "Bureau of Standards" mentioned was in the Edward plant and, when he brought his gages over, he was surprised even more. He saw an array of measuring devices from top instrument manufacturers in Switzerland, Sweden, Germany, England, and the United States worth over $100,000.

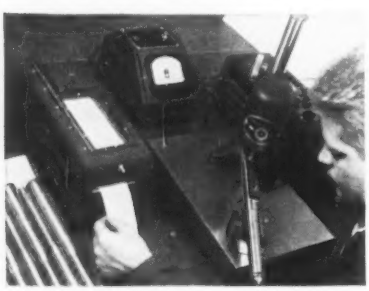
The Edward "Bureau of Standards" is a room centrally located in the manufacturing area that somewhat resembles a dietary kitchen for cleanliness. Sealed windows and glossy white walls help maintain the meticulous care necessary for extreme accuracy. Odd as it may seem, the room is not air conditioned. Temperature differences could cause errors when manufacturing gages or standards are brought in for checking. "Bureau" equipment never goes out.



Jones & Lamson optical comparator checks angle on a reamer by reproducing magnified image on a standard chart.



Three-wire method of checking thread gages with Pratt & Whitney electrically indicating 48" measuring machine permits readings to .00001 inch.



Measuring surface finish of stem with Brush surface analyzer.

Vernier height gage indicator compares dimension of gage with set of Johansson gage blocks. Surface Plate used as base for measuring is flat within 1/10,000 of an inch for entire surface.

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Multi-purpose forged steel valves featured
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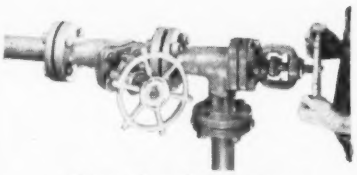
Technical Tips

How to Select, Operate Blow-Off Valves



Edward Blow-Off Set showing a globe and angle combination where both valves are sealing valves of the same simple design with interchangeable parts, positive backseats, stuffing boxes above large condensate cooling chambers, and Stellited seating surfaces.

A few special precautions in selecting and operating your blow-off valves will prolong service life, cut maintenance, and avoid trouble. Here are some of the most important.

Selection Ideas

1. Be certain that in the valve hookup both valves are capable of tight shut-off and will stay tight.

2. Select blow-off valves designed so that the disks lift off the seat on operating instead of grinding against it. This eliminates the possibility of seat-disk galling.

3. Buy blow-off valves with positive backseats to protect and isolate packing in service.

4. Pick blow-off valves with the packing far removed from the high temperature zone.

5. Require that all seating surfaces be Stellite to resist abrasion. Whenever possible, take integral seats in preference to screw-in seats for longer, trouble-free service.

6. Always specify blow-off sets with two valves of same type to permit interchangeability of parts.

7. Above all, avoid gadgety, involved designs. You fundamentally should be interested in long, dependable service and freedom from maintenance.

Operational Pointers

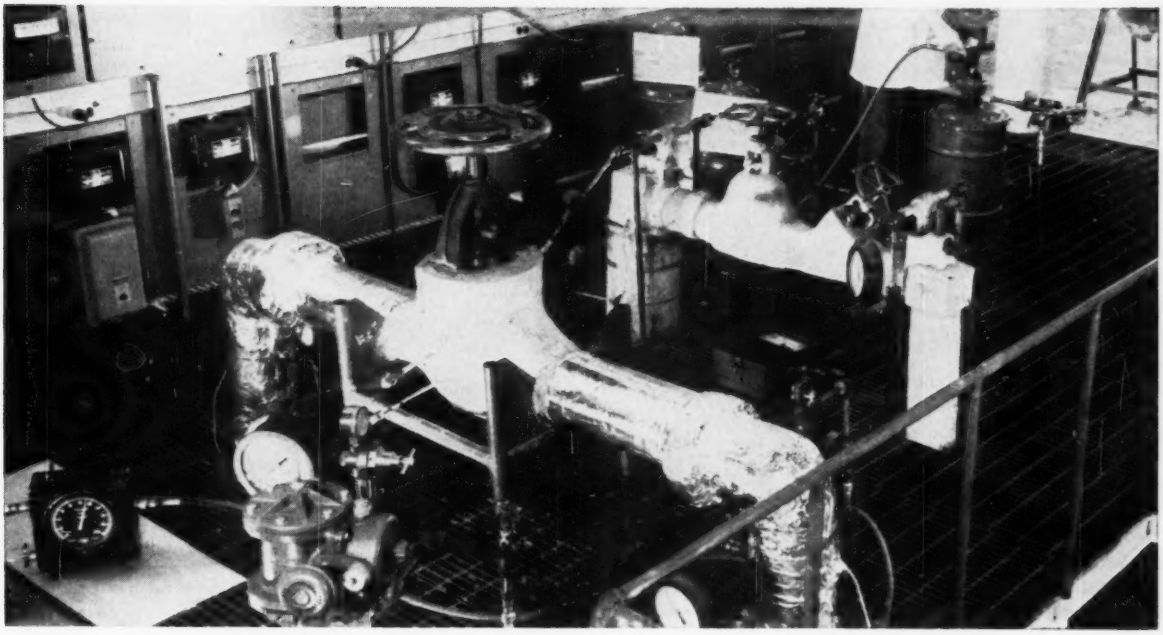
1. During blow-down periods, fully open valve nearer boiler first; then, slowly open other valve. In shutting down, close second valve first; then valve nearer boiler. This procedure places greatest wear on blowing valve and insures a tight valve next to boiler. Should blowing valve show wear or erosion, it can be repaired or replaced without a boiler shutdown.

2. Open blowing valve slowly to prevent slamming and damaging shock to piping.

Many blow-off problems can be eliminated by consulting with competent valve engineers before the piping design is formalized.

COVER PHOTO

Solving special valve problems is one of the main Edward laboratory jobs. This new 10-inch check valve was built for an eastern power plant in stop and check designs to approach venturi gate valve flow characteristics.



Super Critical Steam Research Improves Valve Designs

Data obtained from new experimental procedures lowers cost of valves for high temperature-pressure service, fosters design improvement.

By L. H. Carr, Director of Engineering and Research
Edward Valves, Inc. (Subsidiary of Rockwell Manufacturing Company)

During the past decade, top operating steam-line temperatures have been increased approximately 100°F. Operating pressures have gone up roughly 50%. The effect of these two increases together has meant that today's pressure-containing vehicles must withstand three times the former stresses. And they soon may be called on to withstand still more.

Recent developments in the power and steam process industries indicate another 100°F. rise in operating temperatures is a certainty within the next few years. Thus, precise data on the pressure-containing characteristics of various valve materials and construction methods is immediately necessary.

MANY TESTS OFFER MULTI-BENEFITS

Tests made in Edward Laboratory, particularly those run at supercritical pressures and temperatures above 1150°F.—have furnished valuable information on pressure-containing ability of steel as well as the many design and operating factors needed for high pressure-high temperature service.

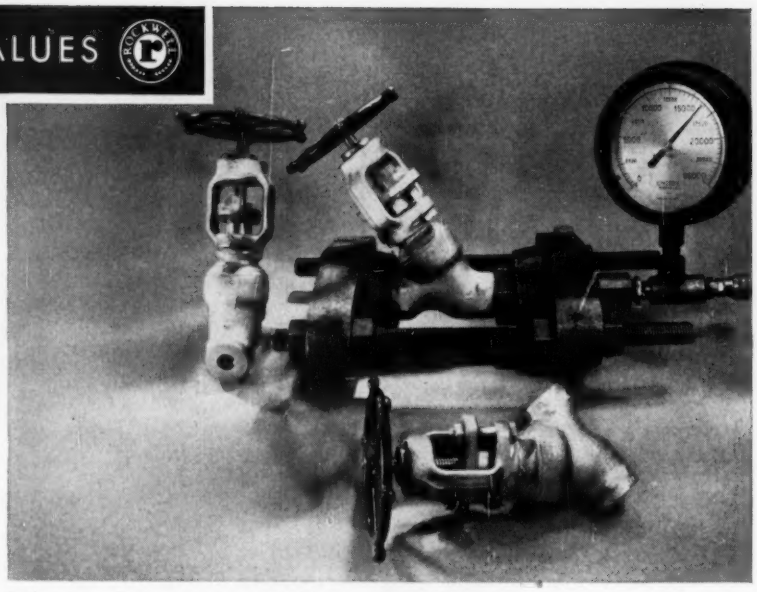
For example, these studies have established torques necessary to close or open valves at various elevated temperatures. They also have demonstrated the effectiveness of stem thread lubricants. Stem packings and packing methods, when exposed to superheated temperatures and pressures over 3000 psi for extended periods, have been evaluated.

Accelerated tests in superheated units show the deformation or swelling of the valve body after a relatively short time, showing the effect of creep on valve life. They accentuate deformation of seat joints and other critical areas in the valve construction, pinpointing any possible difficulty and allowing the designer to devise corrective measures which will prove effective under tomorrow's top service conditions.

Temperature gradients throughout a valve, difficult to calculate accurately, can also be determined. For example, the bonnet end of a 6-inch, 2500 lb. valve may be as much as 300°F. cooler than either the inlet or outlet end. The inside surface of a thoroughly insulated valve body may be 50°F. above the outside surface.

Rockwell-Built EDWARD VALVES

EDWARD VALVE VALUES



Performance of these extra heavy Univalves was established in laboratory before being shipped for super-critical steam service on a boiler generating 4500 lb. sp. at 1150 F.

Safety and safety factors become increasingly more dependable since they can be based on proven results rather than on calculations, theories or assumptions.

Maintenance and disassembly procedures for use after extended service are also tested and proven on the superheater.

But probably the greatest benefit to be derived from this research tool is its use as a proving ground for new materials and designs. For here the theories and calculations of the valve designer and metallurgist are subjected to conditions which duplicate and even exaggerate actual service.

The mortality rate on proposed modifications of design or material substitutions has been high. But the proposed changes which do survive the tests are proven contributions which help meet the constant challenge of increasing temperatures and pressures.

MATHEMATICAL ANALYSIS FIRST

First steps in the investigation of valve strength are comprehensive mathematical calculations of the stresses encountered. Since valve flow-passages most nearly approximate heavy-walled cylinders, the basic formula used is one for maximum stress in a heavy-walled cylinder. Other formulae are used for spherical sections.

However, when these formulae are applied to valve bodies, complicating factors enter the relatively simple computations. For example, cylinder sections are never infinitely long, but are generally modified to a length even shorter than the cylinder diameter. Cylinders are joined to other cylinders, or to flanges. Extra metal is added at some points to simplify foundry practice. Cylinders are flattened at some points while spherical sections in the center of a valve body are almost invariably punctured by three large openings for the inlet, outlet and bonnet end.

All these factors make mathematical computation of stress in valve bodies a difficult task and one which can only produce inadequate results. Mathematical stresses are always computed first, however, for they have great value as guides to further investigation.

STRESS ANALYSIS COMES NEXT

Modern practical tools of experimental stress analysis eliminate many of the uncertainties of purely mathematical methods. Two such procedures are (1) the brittle lacquer technique to survey the outside surface stresses of valve bodies, and (2) the wire resistance strain gage method to measure more accurately strains on both internal and external surfaces.

With the brittle lacquer technique the three ends of the valve body are closed, and the entire surface is sprayed with special lacquer in controlled temperature and humidity conditions. Hydrostatic methods are used to apply internal pressure and the entire lacquer surface examined for stress cracks. Pressure is then released and the areas of the coating which have cracked are outlined and marked with the test pressure. After a suitable interval, higher test pressure is applied and the operation repeated. In this manner, a whole series of pressures is recorded which cause crack patterns of increasing areas to develop over the valve body surface. By attaching electrical wire resistance strain gages, inner and outer crack patterns are mapped and tabulated.

However, experimental stress analysis of this type must be taken at constant room temperature. Now, the question arises—what happens to metal in highly-stressed surface areas under elevated temperature conditions? Obviously creep and relaxation will take place but what will be the effect on the valve body in terms of stress redistribution and total deformation?

SUPERHEATER TESTS ARE ANOTHER AID

To get these answers, valve bodies are next tested in pit type gas furnaces. In these tests, the valve body is partially filled with material, and entrance and outlet pipes inserted. One serves as a water inlet, while the other is connected to a pressure gage, a pressure recorder and a safety rupture disk assembly.

The valve body assembly in the furnace is then brought up to the desired temperature. The water inlet is connected to a pump which introduces water into the valve body where it is converted to superheated steam. Thermocouple and pyrometer controls regulate furnace temperature, allowing the temperature of the valve body to be maintained constantly within plus and minus 5°F. at temperatures as high as 1500°F.

This experimental method has pro-

After designs are verified and valves built, final testing is done in the Edward test department and the laboratory. Here a very sensitive leak detector is being used to check packing and bonnet joint. Leakage as minute as one cc over a 30-year period can be detected with this machine.

Edward 10-inch cast steel check valves built especially for the first large scale super-critical steam generating station in the U.S. Average wall thickness is approximately 4 inches and the port opening is 5¾ inches.

duced many significant results. For example, many investigations with this equipment were deflection tests directed at finding what happened to the high-stressed areas in valve bodies. In one study a 10 in., 900 lb. carbon-steel globe valve body was used. It was tested at 1000°F. and an elastic stress of 24,000 psi. The valve body was heated for 1,000 hours under these conditions. At the end of this time, the temperature was lowered to 700°F., and the pressure relieved. When the valve body was cooled, wire resistance gages were cemented to both internal and external surfaces of the highly-stressed region. A cube of metal containing these gages was cut out and progressively sectioned until each gage was attached to a slice of metal only ⅛" thick. The strain gages showed that the inner surface had a residual compressive stress of 18,000 psi, and the outer surface had a residual compressive stress of 3600 psi. The decrease in valve diameter across a section amounted to .010 in. while the increase in a direction at 90 deg. to this axis, was .035 in. These deflection measurements indicated that very little overall change in dimension was required to redistribute the stresses greatly. The stress at the inner fiber dropped from 24,000 psi to 6,000 psi.

Other important data obtained in this manner includes data on valve rupture, obtained by maintaining valves at extreme temperatures and pressures until failure occurs. Results of these rupture tests in many cases are at wide variance with predictions obtained solely by mathematical analysis.

SUPER-HEATED STEAM TESTS IN SPECIAL EDWARD BOILERS

Tests in furnaces still fail to duplicate regular service conditions in two respects. (1) There is no flow of steam through the valve. (2) Heat is applied first to the valve externally, while in actual operation, the flow of heat is exactly the opposite—superheated steam first heats the valve interior and, last, the exterior.

After much experimentation and years of development work, testing devices were built at Edward which fully duplicate the effects of flowing steam in a boiler system, yet make it possible to far exceed the temperature and pressure limitations of boilers in service today. Each of these units consists essentially of a four-sided steam loop of varying sizes. Test valves are installed in the loop, while heating devices are applied. Valves may be tested by flowing steam at temperatures above 1300°F. and pressures above 5000 psi for indefinite periods of time.

In operation, these "superheaters" are started by setting a temperature control. When the temperature of the loop is high enough to form steam, a treated water is fed to the system by means of control valves and spray tubes. Water is admitted until the pressure within the system approaches the desired figure. At this point regulators on water feed pumps are used as a means of maintaining the desired steam pressure in the system and magnetic circulating pumps maintain desired flow rates. Steam can be circulated at a rate which permits the testing of valves as large as are used in today's systems.

A visit to the Edward Laboratories in East Chicago where the superheater loop is in almost daily operation would probably answer many questions. Although no tours are regularly scheduled, the Edward management and research people are always happy to receive visitors. A note in advance to the sales department will assure you that tests most interesting to you will be in progress.

Rockwell-Built EDWARD VALVES

EDWARD VALVE VALUES

Multi-Purpose Forged Steel Valves Featured in Edward Bulletin 551

General purpose forged steel globe and angle stop valves ½ through 2 inches for services up to 3600 psi W.O.G. are featured in Edward Bulletin 551.

From the oil fields to ships at sea, from large utilities to small industrial installations, hospitals, refineries, chemical plants . . . wherever small piping for water, oil, gas, steam, and most other fluids is used, these Edward valves are giving long, trouble-free service, according to reports.

For example, many inside screw, globe and angle stop valves have been used lately with great success to replace original unsatisfactory valves in Dowtherm service.

Valves listed in Bulletin 551 are available with pipe thread ends or socket welding ends. Sizes ½ through 1 inch have union bonnets with inside screw or outside screw and yoke construction. The larger sizes have bolted bonnets with outside screw and yoke.

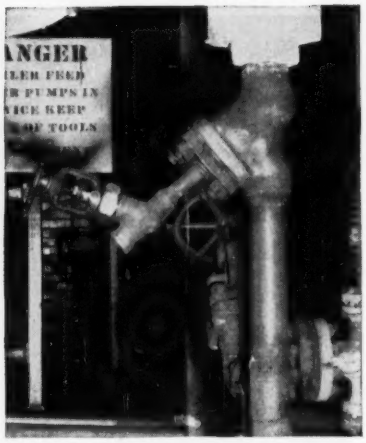
In all bonnets, a beveled backseat forms a line contact with a radiused shoulder on the stem to make a pressure-tight seal. This seal permits adding packing or even repacking the valve under pressure. On O.S. & Y. valves, swing gland bolts and steps on the yoke that hold the gland up leave both hands free for the packing job.

Die molded EValpak is the standard packing used in all Edward forged steel valves. It is an asbestos-graphite material with outer rings wire supported and intermediate rings of a relatively soft plastic. Both types are waterproofed and treated to prevent pitting of stem as well as minimize operating torque.

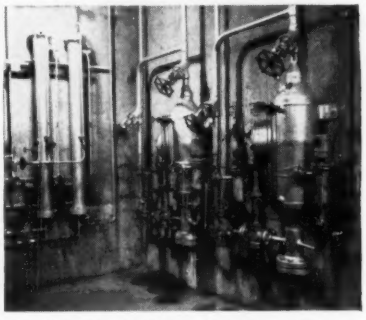
Stellite or EValloy stainless steel hard surfaced seats and disks reduce wear and galling. Screwed in seats are broached for easy turning in the body while long, fine threads and close machine fitting provide a leak-free seat-body joint.

Other features of these all-forged valves include EValized threaded surfaces which resist pitting and galling. EValizing is an exclusive electro-plating process which acts as a lifetime lubricant as well as a protecting coating. Hard bronze yoke bushings, machined in one set-up so that external and internal threads are concentric, further help the easy operation of these valves.

More information on special applications for these forged steel globe and angle stop valves and copies of Edward Bulletin 551 may be obtained from Edward representatives or by writing to Edward Valves, Inc., 1211 West 145th Street, East Chicago, Indiana.



An Edward forged steel globe stop valve used as a drain valve for a strainer in a municipal water pumping station.



Edward forged steel globe and angle stop valves on a hydrogen control oil detraining system for generator cooling in a large Midwestern power station.

Steam Powers Gas Compressors on Transcontinental Pipe Line

Using steam to drive centrifugal compressors for high pressure gas transmission was a pioneer application a few years ago. Now, Transcontinental Gas Pipe Line Corporation, which inaugurated the innovation, is rapidly adding new steam power facilities to its 30-inch main line from Texas to New York.

Typical of these compressor stations is one at Eunice, Louisiana, which opened in July, 1951. Three centrifugal compressors rated at 5000 hp under designed load conditions are driven by individual steam turbines. Each Turbo-Compressor unit is a complete package—condenser, condensate pumps, and all other auxiliary equipment.

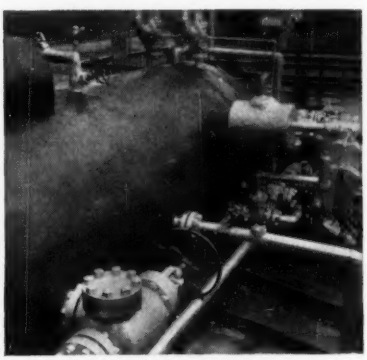
A high degree of instrumentation allows a relatively small crew to run the station. Two 800 KW turbo-generators in the boiler house supply electricity for the automatic shut-down controls, boiler and turbine regulators, and other auxiliary services. Under normal plant load only one generator is needed and the second is a standby.

On the steam, instrument, and feed lines as well as around the three boilers, Edward cast and forged steel non-return, separated stop-check, blow-off, gate, check, instrument, and general purpose globe and angle stop valves are used extensively.

Boilers are gas fired and evaporate 43,000 lbs. of water per hour to 750°F. steam at 600 psi. Make-up water supplied to the boilers is completely demineralized. A large cooling tower removes heat from the circulating water used to condense steam from the turbines.

A remote boiler control panel is located near the compressors to expedite operation from either the boiler house or the compressor building. The main electrical switchboard is in the boiler house.

Other buildings include an office-warehouse-machine shop building, water treatment building, and a meter house where gas used by the plant is measured and pressure regulated.



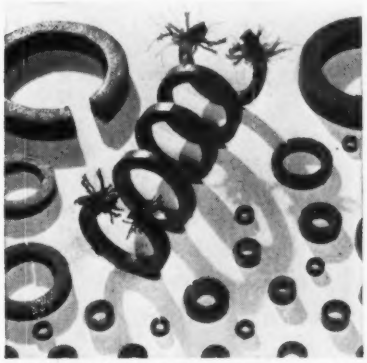
An Edward 2½" Fig. 3551 separated stop and check valve on the feedline and several forged steel general purpose globe stop valves used for vent and drain lines installed on an Eunice Station boiler owned by Transcontinental Gas Pipe Line Corporation.

Valve Packing

The success of efforts to minimize pitting of 13 per cent chromium steel stems goes back many years when investigations revealed that most stem pitting got its foothold when valves were held in storage before installation.

Water was obviously the predominant contributing factor to stem pitting, but since it was impossible to avoid humidity and water in hydrostatic testing, Edward engineers turned to the remaining factors—the stem and the packing.

Early research proved it was neither practical nor logical to replace the EValloy stainless steel stem because of the many desirable characteristics of this material for valve trim.



THIS IS EDWARD EValpak in various sizes—a tailor-made packing famous for dependable service. Note, center, that top and bottom rings of an EValpak set are wire reinforced for greater strength. All rings are specially treated to prevent stem pitting.

Many packings then underwent exhaustive tests to determine whether substitutions in packing ingredients could be made and whether special processing of the best packing would help. It became apparent after much work that waterproofing the packing was closer to the solution than anything else yet tried.

Waterproofing experiments continued until Edward research engineers found that by dipping the packing at a controlled temperature in a special base liquid and giving it a protective covering they could keep the packing from absorbing water.

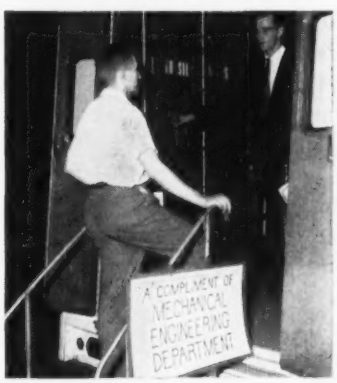
Edward stem packing—trade-named EValpak—is thus specially treated to minimize stem pitting.

VALVES *(and valve people)* IN THE NEWS

Edward Valvemobile Exhibited at Illinois Tech "Technorama"

The Edward Valvemobile, our mobile valve display unit, was exhibited at the Illinois Institute of Technology's three-day "Technorama" recently. This elaborate exhibit showed students, prospective students and the general public fields of study and accomplishments of the different departments at Illinois Tech. Our share was to display the more than 30 cut-away steel valves mounted permanently in the Valvemobile with latest design features; pictures of typical installations using steel valves; and a "do-it-yourself" display where visitors could "build" a Pressure-Seal valve on a stainless steel panel using differently colored wooden replicas of each part.

So the Valvemobile rolls on. Since 1954, it has travelled 50,000 miles and has been shown to nearly 20,000 engineers, piping designers, maintenance personnel and students at power plants, universities, industrial plants and power shows. It is scheduled soon to begin a six month trip through the West.



Frank Wendt, Edward sales engineer, standing in front of the forged steel valve rack, welcomes a Technorama visitor to the Edward Valvemobile.

Jack Watson, left, of Charles H. Tate Company, Cleveland receives an engraved sterling silver ash tray from R.A. Durand, Edward sales manager, for making the highest score in a "valve knowledge" examination during a sales meeting.

Quiz King

As many, many of you may know, Jack Watson, of Cleveland, Ohio, was crowned "Edward Sales Quiz Champ" at the Edward recent sales meeting in East Chicago. Watson, a member of Charles H. Tate Company, exclusive Edward representative in the Cleveland area, scored 95½ points out of a possible 100 in a tough exam on valve knowledge.

Over 30 other Edward sales engineers and representatives from the United States, Cuba, and Canada were given a refresher course in valve engineering during the four-day session. Besides a heavy schedule of lectures, the group made a plant trip to see the latest manufacturing techniques and new products being developed.

A highlight of the field trip was a visit to the Edward laboratory which will more than double in size when the new addition is completed this summer. The new section will be devoted largely to nuclear valve research.

EDWARD VALVES, INC.
Subsidiary of Rockwell Manufacturing Company
1230 WEST 145th STREET,
EAST CHICAGO, INDIANA

I want more information. Send me:
☐ Your condensed valve catalog
☐ Blow-off valve catalog
☐ Bulletin 551
☐ Reprint of this *Valve Values*

Name_____ Title_____
Company_____
Address_____
City_____ Zone_____ State_____

Planetary Roll and

complements the Foster Wheeler line of pulverized fuel systems

THE FOSTER WHEELER Type MB planetary roll and table pulverizer, developed in Germany, is a constant-speed mill which has proved to be exceptionally efficient and economical to operate and maintain.

In the MB pulverizer, grinding action takes place between a slowly rotating horizontal table and three spheroidal rollers, uniformly spaced around the axis of the table and subjected to controlled thrust pressure by a large number of coil springs. The motion of the table causes the rollers to rotate while circling planet-fashion and rolling over the material on the grinding ring.

Air or gas, entering from below the pulverizer table, floats the ground particles up into the classifier, located in the top of the housing. Particles too coarse to float fall back onto the table for further pulverization. All routine adjustments to the spring tension gear or classifier vanes can be made externally while the mill is in operation.

Wide experience abroad indicates that this new addition to the complete line of heavy-duty FW pulverizers offers the following advantages.

1. *Low Power Consumption*

Assures exceptional economy of operation, year after year.

2. *Low Maintenance*

Extremely rugged construction and accessibility of wearing parts reduces down-time for servicing.

3. *Uniform Product Fineness*

Pulverizer and classifier design assures extreme uniformity of particle size.

4. *Pressurized or Suction Operation*

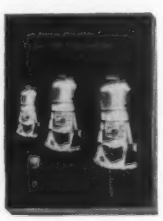
Provides complete flexibility for various types of service.

5. *All Necessary Adjustments Made Externally with Mill Operating*

Avoids shut-downs for changes in pulverizer pressure or classifier adjustment.

6. *Simple Renewal and Replacement of Grinding Rolls and Table*

Cuts down-time for infrequent replacement of wearing parts.



THE TYPE MB PULVERIZER, with Foster Wheeler feeders, distributors, burners and fans or exhausters, provides an exceptionally efficient and economical pulverized fuel system.

For complete information on the new PLANETARY ROLL & TABLE PULVERIZER, write for Bulletin MB-55-5.

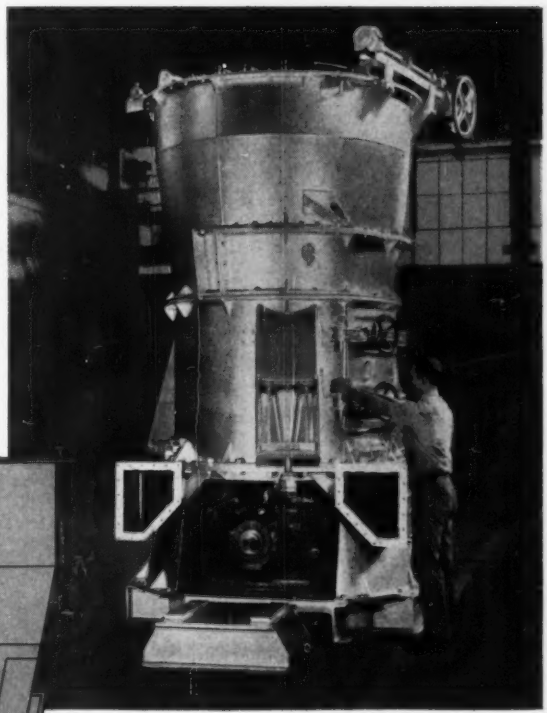
For full details on Foster Wheeler heavy-duty BALL MILL pulverized fuel systems, write for Bulletin BP-53-3.

Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.

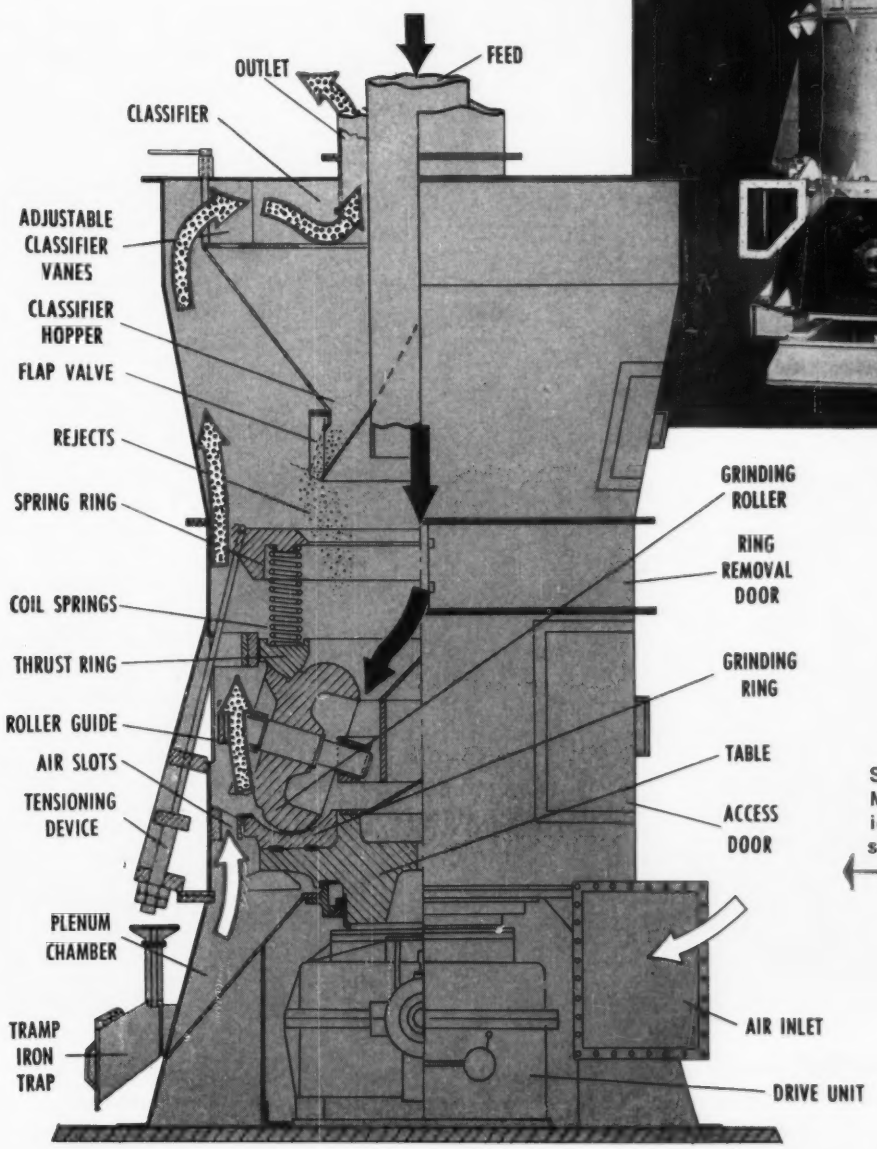
FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

Table Pulverizer

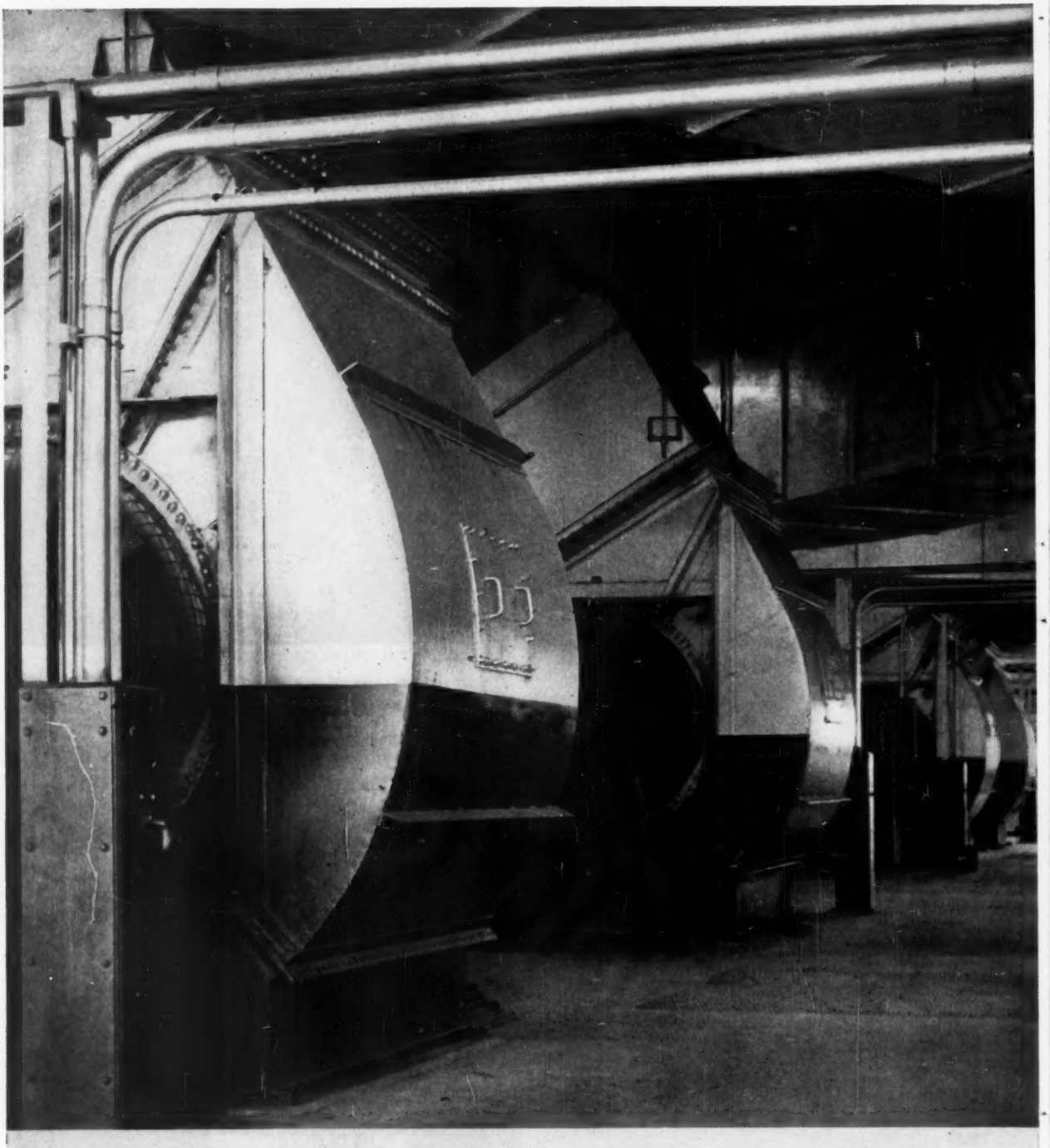


Exterior view of completely assembled Foster Wheeler Type MB planetary roll and table pulverizer.



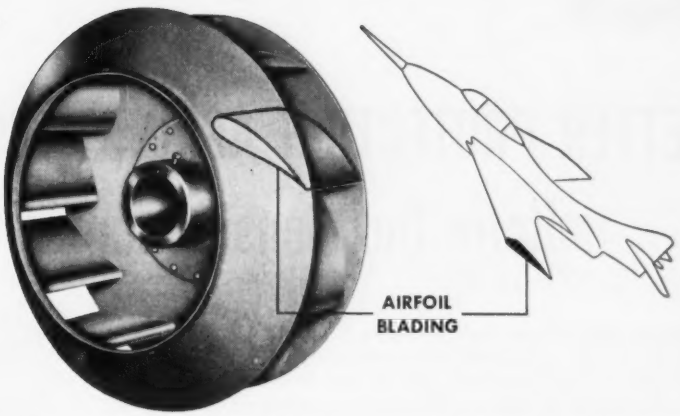
Sectional drawing of Type MB pulverizer with parts identified to show construction and operation.

5 YEAR RECORD! 176 Customers



5 YEARS' USE PROVED! Westinghouse first announced the application of Airfoil Blade design to Centrifugal fan wheels in 1950 — has since supplied more than any other company to leading power plants. Proved in use, benefits to users include reduced turbulence in air flow pattern which markedly reduces operating noise . . . up to 92% mechanical efficiency because of backwardly-inclined blades . . . lowest cost operation.

Select Westinghouse Heavy-Duty Airfoil Fans



Today 381 Fans serve Utilities and Industry

Some of the reasons why 176 leading utilities and industrial plants all over the country have specified Westinghouse-pioneered Airfoil Blading design in centrifugal fan wheels are lower operating costs, marked reduction in operating noise, and *up to 92% mechanical efficiency delivered on the job.*

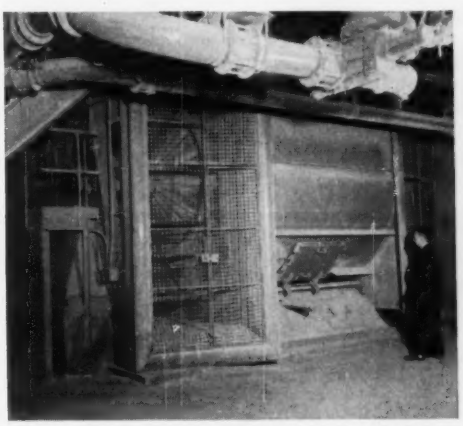
Since its introduction 5 years ago, this Westinghouse design has proved itself in mechanical draft and heavy-duty air supply services — with these advantages. Ideally-suited for parallel operation for higher CFM delivery. Self-limiting horsepower characteristic of the wheel reaches its maximum in normal range of selection. True non-overloading horsepower is assured by this wheel design, and wheel proportions permit direct drive by standard squirrel-cage induction motors without costly shafting and outboard bearings.

Ask your nearest Sturtevant Power Sales Engineer for full details, or write Westinghouse Electric Corporation, Sturtevant Division, Dept. 24A, Hyde Park, Boston 36, Massachusetts.

Westinghouse Heavy-Duty Airfoil Fans Now Serve These Leading Plants

- Consolidated Edison
- Powaters-Southern Paper Co.
- Kaiser Aluminum & Chemical Corp.
- Ohio Valley Electric Corp.
- Duke Power Company
- Delaware Power & Light Co.
- International Paper Company
- Duquesne Light Co.
- Indiana-Kentucky Electric Corp.
- Pennsylvania Electric Corp.
- Southern California Edison Co
- Tennessee Valley Authority
- Pittsburgh Plate Glass Co.
- Philadelphia Electric Co.
- Commonwealth Edison
- Dayton Power & Light
- Gulf States Utilities, Louisiana
- Cleveland Electric Illuminating Co.

and 158 more plants — a total of 381 fans!



Fan installation at Astoria Station, Con Edison of N. Y. . . . first to specify Westinghouse Airfoil fans. 8 fans in 2 parallel sets supply 600,000 cfm of forced draft air to twin boilers.

WESTINGHOUSE AIR HANDLING

YOU CAN BE SURE...IF IT'S Westinghouse

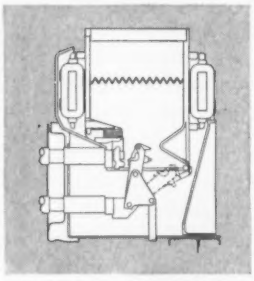
J-80602

METAL-CLAD SWITCHGEAR

BETTER PROTECTION AGAINST HIGH CURRENT FAULTS

uniform flux density across whole arc chute

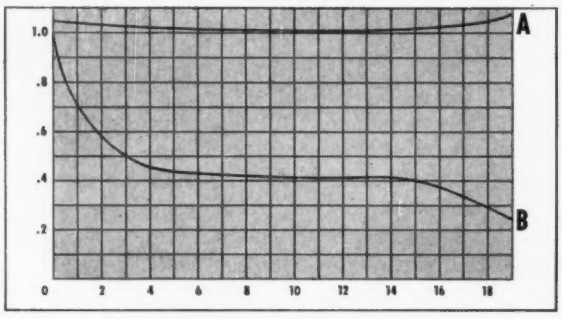
When a high current fault opens an I-T-E 15 kv circuit breaker, the arc is practically swallowed up in the arc chute—faster and over a longer path than has ever before been possible. The reason lies in two unique construction features found only in I-T-E circuit breakers:



Path of arc through chute equipped with twin coils.

1. Twin coils and closed loop magnet. Arc current through the twin blowout coils develops a stronger flux density that is uniform across the entire arc chute. Arc is stretched farther, faster—cooled and extinguished in less time. And the forward part of the arc chute comes into use just as much as the back part. So arc chute life is significantly prolonged.

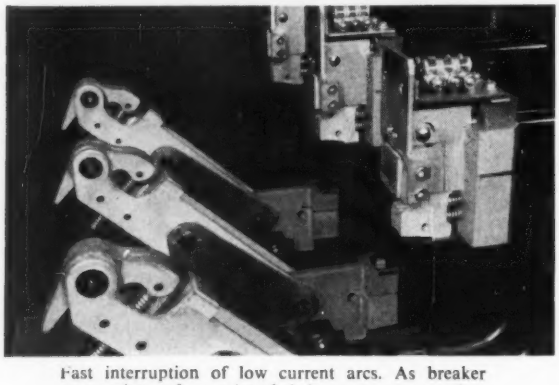
2. Laminated iron of transformer quality. This superior iron construction keeps losses to a minimum. Magnetic field is not only stronger, but rises and falls in phase with the current through the arc. Thus the greatest magnetic pull on the arc occurs when it is most needed—at the top of the current cycles. These are both extra-quality construction features of the sort you can expect to find in I-T-E switchgear. All together,



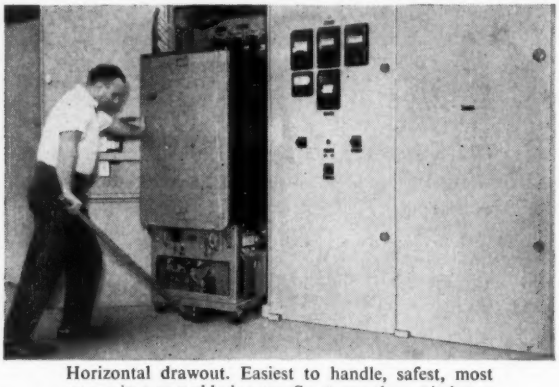
Flux density across entire length of arc chute.
A. Twin coil B. Single coil

I-T-E quality means generally superior performance, better endurance under handling, and longer life in service. Yet it costs you no more.

Get complete information on I-T-E metal-clad switchgear—and the many engineering services available to help you realize greater economy and satisfaction in a system that meets your requirements. Available in ratings from 2.3 through 13.8 kv, 50 through 750 mva interrupting, and up to 3000 amperes continuous. Write to I-T-E Circuit Breaker Company, Switchgear Division, 19th & Hamilton Sts., Phila. 30, Pa.



Fast interruption of low current arcs. As breaker opens, pistons force a jet of air between contact points—driving arc up into arc chute.

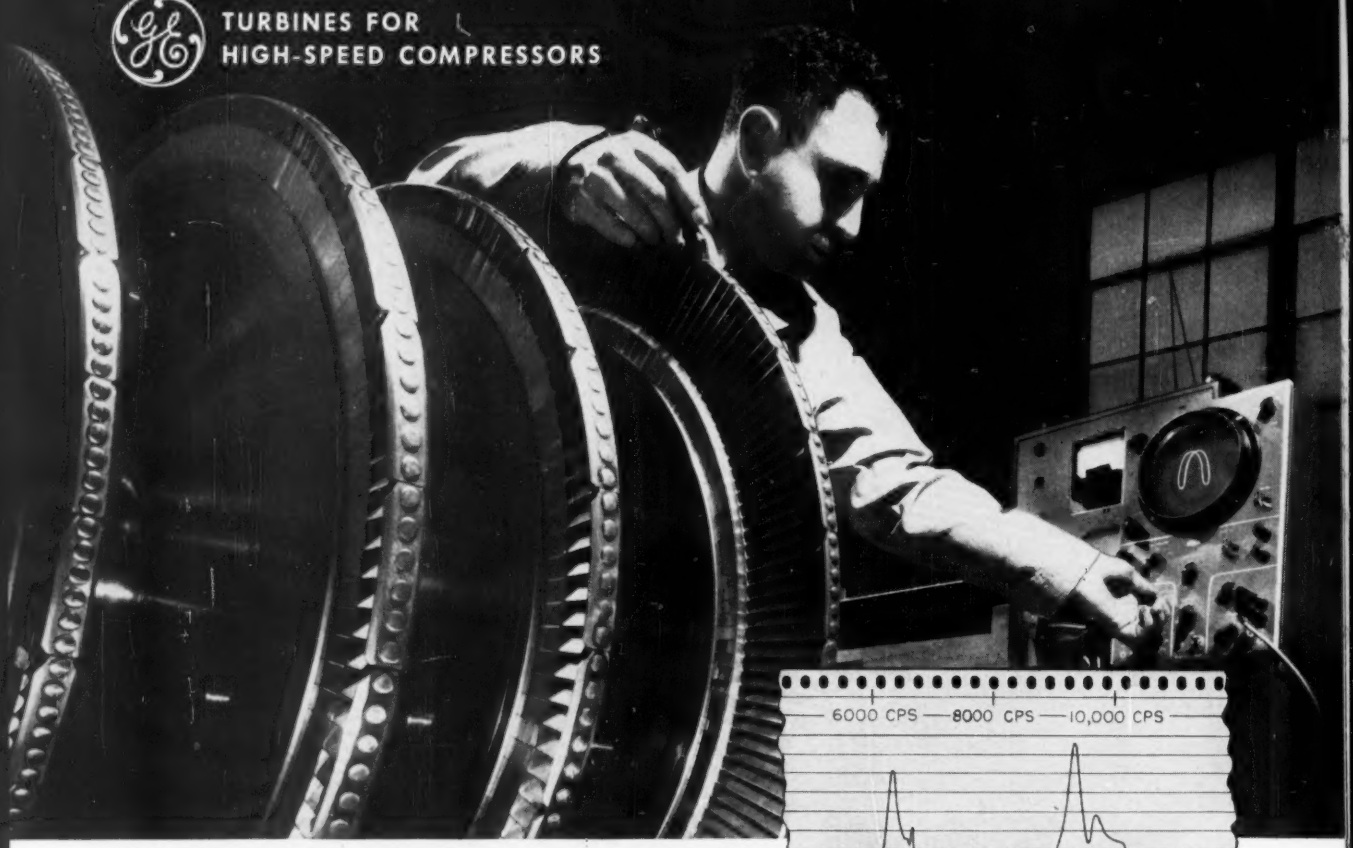


Horizontal drawout. Easiest to handle, safest, most convenient assembly known. So strong that switchgear is shipped factory assembled and ready for installation.

I-T-E CIRCUIT BREAKER COMPANY—Switchgear Division

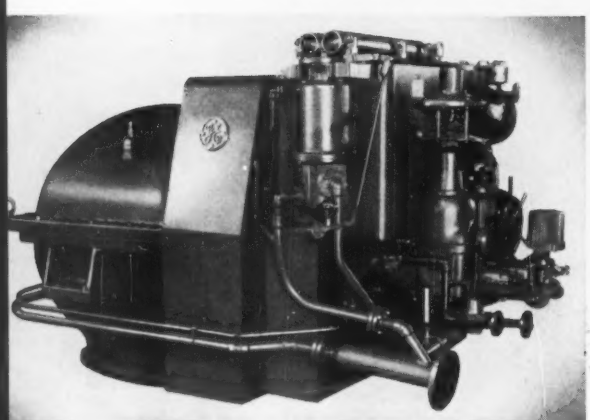
TWIN COILS
CLOSED MAGNET LOOP
Laminated Iron
of Transformer Quality
I-T-E

TURBINES FOR
HIGH-SPEED COMPRESSORS



VIBRATION RECORD, inset, is obtained by exciting buckets. Peaks indicate resonant vibration response of buckets. For more reliable operation, G-E engineers confine bucket exciting frequencies to "quiet zones" between the peaks.

How General Electric Engineers Locate "Quiet Zones" for Safer High-speed Turbine Operation



TYPE DRV HIGH-SPEED MECHANICAL-DRIVE TURBINE

* In Canada, contact Canadian General Electric
107 Park St., Peterborough, Ontario

When driving modern compressors and blowers, G-E high-speed turbines spin at operating speeds of 7000 rpm and up. At such speeds, if resonant vibration were not controlled carefully, bucket fatigue failure might result.

HERE'S HOW General Electric combats the problem: Natural vibration frequencies of the buckets on each new turbine rotor are determined with the special equipment shown above—an oscillator, crystal pick-up, and high-speed level recorder. "Quiet zones" of minimum normal vibration are clearly revealed.

With this information available, the number of nozzles can be varied so that steam striking the buckets will create vibration-exciting frequencies only in these "quiet zones." By thus making sure that steam-impact frequencies don't coincide with critical natural frequencies, the chance of bucket failure is greatly reduced.

VIBRATION TESTING is one of many features adding to G-E high-speed turbine reliability. For more information, contact your G-E Apparatus Sales Office* or write for bulletin GEA-6232, Section 241-2, General Electric Company, Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Byron Jackson announces FIRST 4 in 1 Condensate Pump!

1. Saves valuable floor space 2. One driver serves four pumps 3. Common shaft for all units gives increased reliability

This new Byron Jackson vertical unit actually contains four pumps in a common case, utilizing a common shaft. It saves valuable floor space and cuts operating costs because a single electric motor serves four pumps. Reliability of operation is increased because the use of a common shaft requires only a single stuffingbox – reducing packing maintenance. Three of the four pumps are single-stage and the fourth is a two-stage with external crossover. Axial and radial hydraulic balance is obtained by using double suction impellers and double voluted pump cases.

The outer casing is the vertically split type, with the four sets of inlet and outlet nozzles located in one half to allow the removal of the rotating element without disturbing the suction or discharge piping.

This pump has been successfully used for more than a year by a major power company. It was specially engineered by Byron Jackson to meet particular requirements of Burns & Roe, Inc., engineers and constructors in the power generating field. If space-saving is an important consideration in your plant, this new BJ multi-pump is designed for you. Call your nearby BJ Pump sales engineer or write:

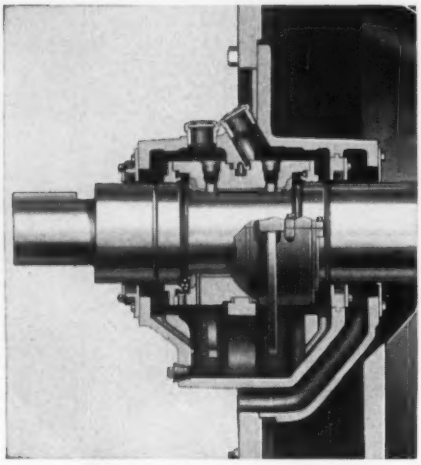
BJ

Byron Jackson Pumps, Inc.
A Subsidiary of Borg-Warner Corporation

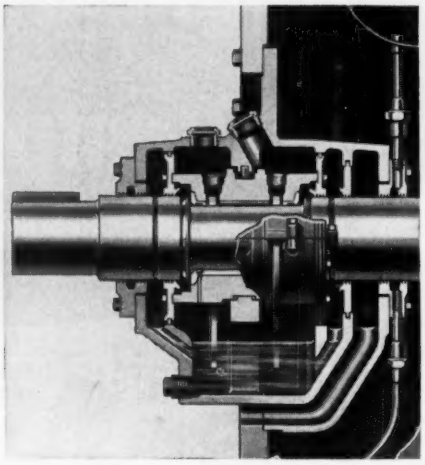
P.O. Box 2017A
Terminal Annex
Los Angeles 54, California

NEW Bearing Design Means Better Motor Performance

Allis-Chalmers capsule-type sleeve bearings now perfected for complete motor line



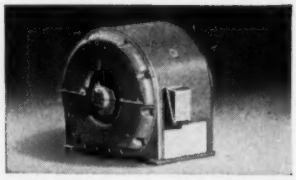
Standard capsule-type sleeve bearing



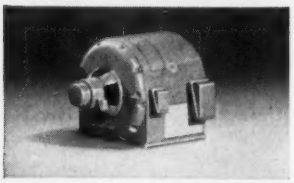
High speed capsule-type sleeve bearing

A new feature—an improved capsule-type bearing design—has been added to the Allis-Chalmers complete line of large end-shield bearing motors. This new bearing will give you better motor service, simplified maintenance and longer motor life through features like:

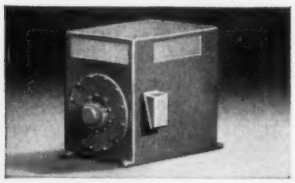
- Dust-tight, leakproof enclosure protects bearing from dirt, dust or abrasive materials.
- Venting system prevents oil leakage — keeps oil and vapor from getting into motor enclosure.
- Dual oil-rings insure bearing surface lubrication — either ring can adequately lubricate bearing.
- Split end-shield gives easy accessibility to winding and air gap — without disturbing capsule or bearing alignment.



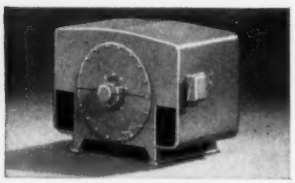
Drip-proof or splash-proof cage motor



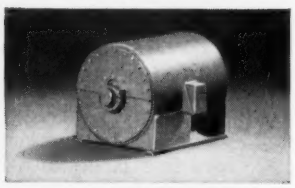
Synchronous or wound-rotor motor



High speed cage motor

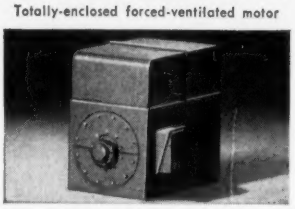


Weather-protected motor



Totally-enclosed fan-cooled motor

Totally-enclosed forced-ventilated motor



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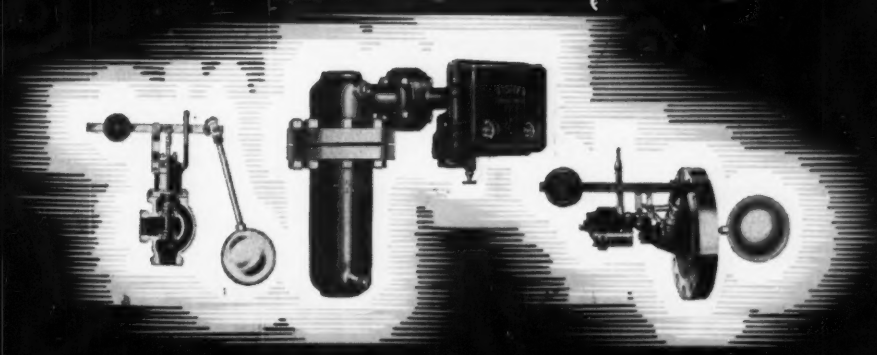

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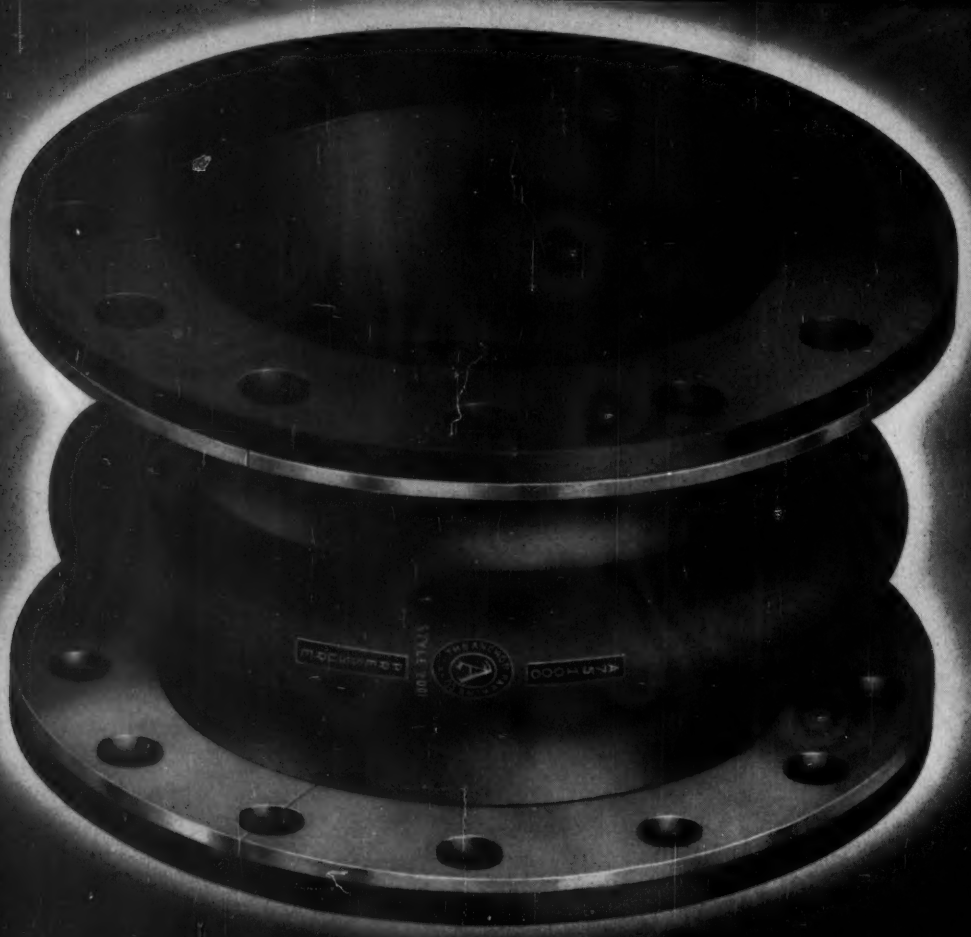

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LOUIS N ROWLEY, EDITOR • JANUARY 1957 • ESTABLISHED 1882 Power

Challenge of the future

SEVENTY-FIVE YEARS AGO, when what is now POWER was born, a revolution was in the making—a technological revolution that was to put at the disposal of each U.S. citizen more energy than ever available to the average citizen of any nation, past or present, and to give the U.S. the highest living standard the world has ever known.

The year 1882 opened on a world still dependent on the waterwheel and steam engine, a world in which power was made where it was used because there was no effective means of transmitting energy over any but short distances. But it was a world astir with the forces of change, a world just beginning to grasp the implications of a new, incredibly flexible form of energy—electricity.

Edison's pioneer central station at Pearl St in New York, which supplied its first customers on Sept 4, 1882, foreshadowed the pattern of the future. But many things had to happen before the promise could be fulfilled. The steam turbine and improved boilers made possible the larger plants that were needed. The polyphase ac system gave electricity the reach and flexibility essential to wide-scale application.

In addition to these key developments, which might be called the foundations on which today's electrical systems are built, the past 75 years have seen many other advances. They have seen the invention and application of new prime movers—first the diesel and, more recently, the gas turbine. They have seen continuous progress in such power services as compressed air and refrigeration, and the advent of completely new ones such as air conditioning. And they have seen the first steps toward tapping the vast energy potential of the atom.

To the reporting and interpreting of this ever-changing technology, POWER has been dedicated for the past three-quarters of a century. In September of this year, a special anniversary issue will mark the rounding out of 75 years of editorial service to the men who design, build, operate and maintain the power and plant services. This will be, we believe, an appropriate time to glance back over the paths that have led us to the complex power-service world of today.

But, even more important, it will be a time to look ahead. In the years to come, we will tap new energy sources, apply energy in ways yet unheard of, consume energy at rates that would now seem fantastic. We *must* do these things if we are to meet the soaring needs of an ever bigger population demanding more and more energy to sustain a dynamically expanding economy.

Thus, if we can maintain peace in a world of tensions, the future for power men has never been brighter. Never have our engineering skills and ingenuity been more needed; never have our opportunities for achievement been greater. And never has a vital, forward-looking power-field editorial service been more essential. To the continued provision of such a service we on POWER repledge ourselves as we enter this anniversary year.

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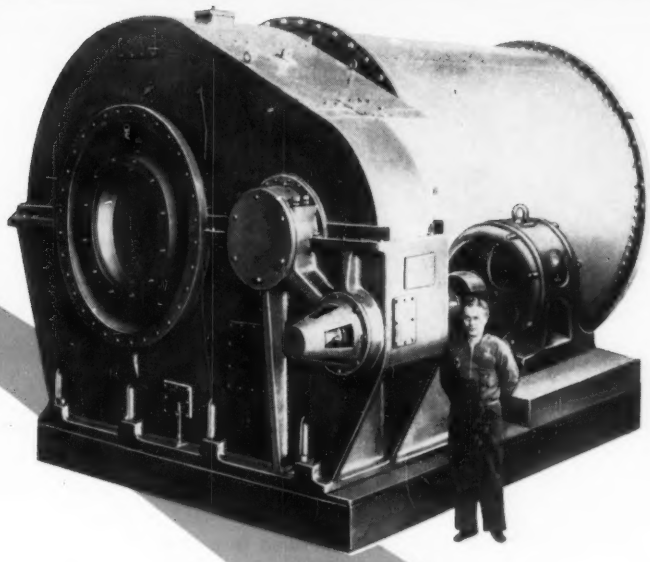

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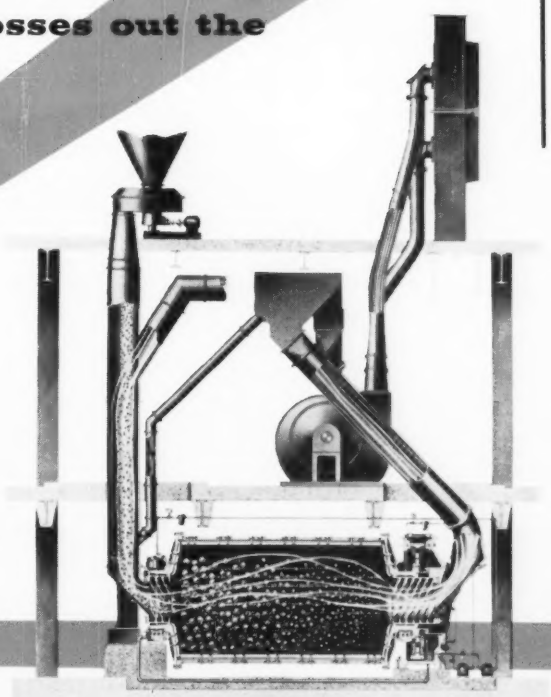

COAL FIRING SYSTEM

Cutaway drawing of Kennedy Pulverized Coal Firing System showing disc feeder, pulverizer, classifier, exhauster, burner. Raw coal is delivered to disc feeder and fed into tube mill.

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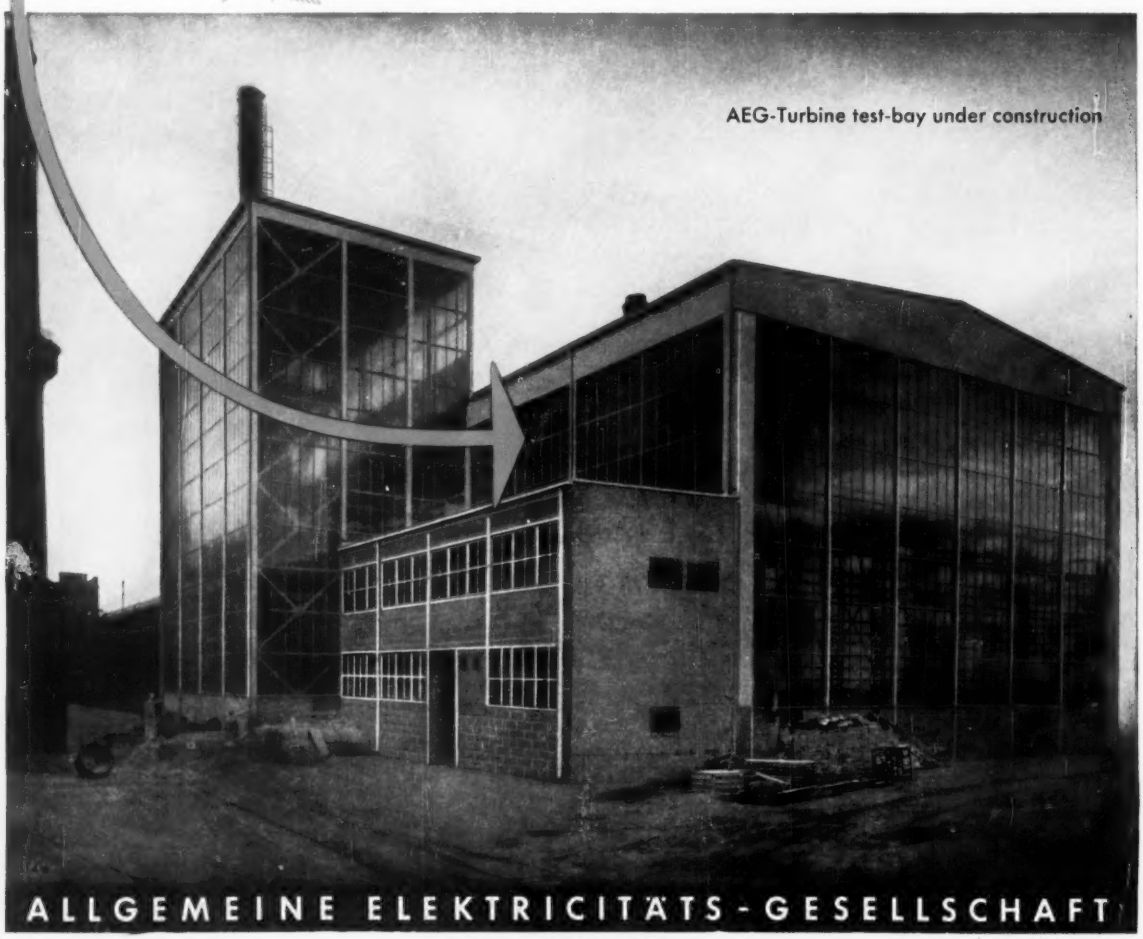

AEG-Turbine test-bay under construction

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B G A SKROTZKI
Associate Editor in Charge

For equal system capacity: h-t water vs h-p steam distribution

It's one big reason why you may swing over to...

H-t water for your next heating system

By P L GEIRINGER, *Chief Engineer*
B M VENABLE, *Project Engineer*
American Hydrotherm Corp

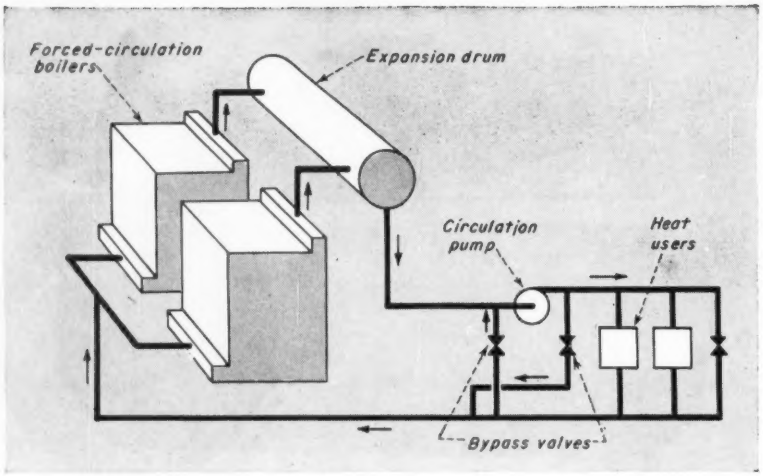
► TAKE A GOOD LOOK at the drawings above. You're viewing pipe cross sections of two heating distribution systems. Both have equal heating capacity. But the high-temperature (h-t) water costs about 20% less than the high-pressure (h-p) steam distribution system. It's one reason why h-t water is moving into the commercial and industrial heating picture in a big way.

You'll find other important points in its favor too: Lower operating costs, little maintenance and repair, operating safety, to mention a few.

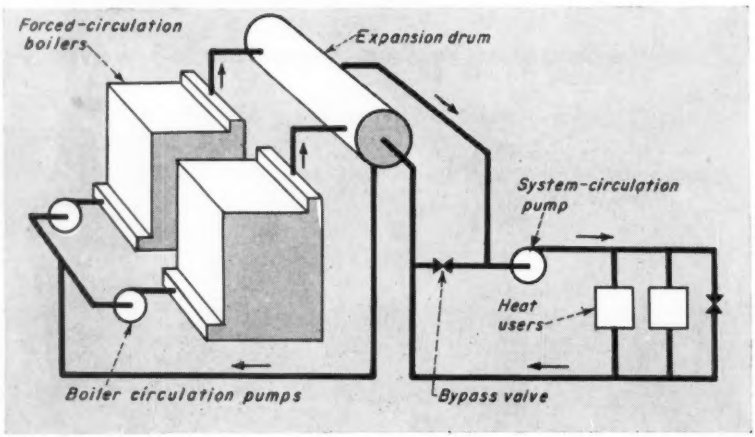
What are its basic principles? How far has it come? Where is it likely to make its biggest inroads? How can *you* capitalize on its advantages? We'll answer these questions in this leadoff article. In a follow-up story we'll dig into design problems. (Also see POWER, April 1954, pp 96-99.)

H-t water puts its best foot forward where it furnishes central heating to buildings spread out over large areas. Water, under pressure, up to 400 F is the most common heat-transfer medium. But engineers also use the physical properties of other liquids to get high-temperature, low-pressure operation. Some designs even call for atmospheric pressure, permitting operation without a licensed operator.

H-t water, in its present form, dates back to German development work during the early 1920's. Since its introduction to the U.S. in 1934, h-t water has made steady progress in the build-



ONE PUMP SET circulates water from the expansion drum through the distribution system, boilers and back to the drum. Single pump set designs are low cost but lack flexibility



SEPARATE PUMP SETS for circulating water through boiler system and through distribution system permits shutting down boiler or distribution systems temporarily without interrupting service

ing and process heating field. The U.S. Air Force has standardized on h-t water for all air bases with building loads upwards of 1000 hp (about 35,000-lb-per-hr steam). First Air Force installation, in 1950, was at Limestone, Maine. Lockbourne Air Force Base near Columbus, Ohio, came next. Here, several hundred buildings, some as far as two miles from the central heating plant, get h-t water heating. Since then the Air Force has put six more h-t water installations in service and many more are in the design or construction stages.

Keynote of h-t system design is simplicity. The system is a closed loop, without steam traps, condensate returns and pressure-reducing valves. Usual design calls for heating water to 330-400 F at 90-232 psig. Temperature drop between supply and return water is between 50-180 F. A conventional steam boiler heats water. An expansion tank, filled partly with hot water and partly with steam, holds line pressure within close limits. Pressure of steam cushion in the expansion tank, sketch, top of page, keeps water in a *superheated state*. [EDITOR'S NOTE: We normally reserve the term *superheat* for steam heated above its saturation temperature at any given pressure. But h-t system design engineers have tagged heated, pressurized water as superheated water].

H-t supply water enters the distribution system just below expansion tank's water line, where temperature is highest. Return water comes back to tank and mixes with hot water from the boiler. Small quantity of makeup water compensates for leakage at the circulating pumps. Heat consumers actually use lower-temperature water or low-pressure steam supplied through heat exchangers at using areas.

Main methods of producing h-t water are: (1) directly, in a forced-circulation boiler (2) cascaded, in a direct-contact water heater that raises water temperature to within 2 F of entering steam temperature. Most installations use forced circulation. But some industrial plants, capitalizing on an existing supply of steam, have put cascade designs to work. Cascade systems are a logical choice for industrials that have a source of exhaust steam that would otherwise be lost.

Major components of h-t water-heating systems using forced circulation are: (1) boilers, that transfer heat from combustion products to the water (2) expansion tank, to absorb water as temperature rises (3) centrifugal pumps, to circulate h-t water through boilers and to distribute it to heat-using areas (4) distribution system, consisting of supply and return piping (5) heat exchangers, to utilize distributed heat.

You can fire boilers with any of the common fuels—coal, oil, gas or waste combustibles. Operation with pneumatic or electronic controls works well. But even manual operation is OK if you don't require close temperature control.

Let's take a closer look at forced-circulation designs. They fall into three major classes.

Single-pump systems, drawing, top of page, circulates water from expansion drum through distribution system, boilers and back to drum. Space above water in expansion drum contains

How high-pressure steam, high-temperature water systems compare . . .

Item	High-Pressure Steam	High-Temperature Water	Percent Reduction in Operating Costs with HTW as Compared to HPS
Heat losses through insulation	Thermal transmission efficiency approximately 90%.	Thermal transmission efficiency approximately 93% to 95%. This is due to smaller flow line pipe size.	3% (*)
Heating of make-up feed water (a) Flash-out vapor losses (b) Improper operation of traps and pressure reducing valves	Condensate flash-out losses; leakage of flanges, valve stems, reducing valves and operation of traps which discharge condensate and live steam to sewers account for losses of 15% to 20% of steam sent out.	No flash-out losses. No traps or pressure reducing valves. Leakage reduced to minute losses from pump glands and valve packing.	15%
Blowdown losses	Frequent blowdown due to amount and nature of makeup cause losses of 1½ to 3% of total boiler output.	The same water is continually recirculated, thus eliminating necessity of frequent blowdown.	1%
Uneven firing	Peak loads cause uneven firing and excessively high stack losses.	Heat accumulated in distribution system water absorbs peak loads. Boiler efficiency is higher.	1%
Pumping costs	Pumping of condensate and boiler feed. Comparatively small quantity at high head.	Pumping of water through system. Large quantity at low head.	Approximately equal for both systems

NOTES

*(a) Considering only main lines of both systems under study; including effect of higher temperature of the H T W flow line. This percentage will increase when branch line size ratios are considered.

(b) Refer to the operating statistics of district heating companies during twenty year period from 1927 to 1946 (National District Heating Handbook; 3rd Edition page 212)

. . . on a design basis

. . . on a maintenance basis

Item	High-Pressure Steam	High-Temperature Water
Piping	Steel condensate piping must be renewed frequently due to the high rate of corrosion resulting from oxygen in the condensate.	Piping has almost infinite life because internal corrosion and scale formation do not occur in a closed system.
Boiler	Maintenance caused by scale formation.	No scale formation.
Reducing valves and traps	Subject to maintenance.	These items eliminated in a high temperature water system.
Pumps	Condensate and boiler-feed pumps require maintenance. Condensate pumps widely dispersed.	Circulating pumps require maintenance.

steam. But system lacks flexibility since it depends on one pump. Pump failure shuts down both boilers and distribution system. Also, operating costs are higher than for a system using separate circulating pumps. *Reason:* All water must circulate around the entire loop, boosting heat losses—especially during low-load periods.

Variation of single-pump system uses one set of pumps in a series circuit. But the expansion drum connects to system through a stand pipe, in much the same way as domestic hot-water heating systems. Space above water in the expansion drum contains compressed air.

This design, too, lacks flexibility. And since water in expansion drum doesn't circulate through the system, a good part of the heat-storage benefits of h-t water heating are lost. What's more, air in the drum increases danger of corrosion. Thus, corrosion-inhibiting chemical injection is a must.

Two-pump system holds several important advantages over single-pump systems. One set of pumps circulates water from a point just below water level in expansion drum, where temper-

'High heat-storage capacity of h-t water—as much as 25 times that of h-p steam—yields smooth, uninterrupted flow of Btus to widely separated consuming areas'

ature is highest, through distribution system and back to bottom of expansion drum. Second pump set takes water from cooler part of the drum, forces it through boilers where it picks up heat and returns to the expansion drum. This setup yields maximum flexibility and economical operation.

If you need to shut down the boiler or boiler-circulating pump for a short period, heat-storage capacity of the expansion drum takes over and allows you to supply heat-using areas without interruption. During distribution system shutdown, boilers maintain heat in the expansion drum, prevent collapse of steam in the drum's expansion section and provide rapid heat-level recovery when the system again swings into operation.

Two expansion drums instead of one help you get even more flexibility—especially if your requirements call for a multi-boiler installation. This setup permits you to do maintenance work on either expansion drum without an overall plant shutdown. Large systems justify cost of this arrangement.

Savings you can pocket by going to h-t water are impressive. Trimming 10% off capital investment, 25% off fuel and operating costs and as much as 75% off repair and maintenance bills, isn't uncommon. These figures naturally vary, depending on specific economics of your installation.

Savings are likely to breakdown like this: Savings on initial cost of the boiler and building. This can come to a shade over 10% of your total investment. For a 4000-hp (approximately 140,000 - lb - per - hr) installation, such savings can reach $200,000. Let's see how it mounts up.

Smaller boiler. A h-t water boiler is only about 85% as large as an equivalent boiler for h-p steam. Heat stored in the large loop of the h-t water system absorbs fluctuating and peak loads. Thus you get lower heat losses.

Less makeup water. H-t water systems need only a fraction of 1% makeup water. An efficient h-p steam heating plant can go as high as 15 to 25% of rated boiler evaporation due largely to condensate losses and wasted steam.

Smaller boilerhouse, resulting from smaller boilers and elimination of water-treating equipment, yields construction savings of about 15%.

Simplified distribution system, drawings page 75 and table, bottom page 78, can cut installation costs by about 20%. H-t system uses smaller pipe sizes. Excavation costs less too, because pipes can follow contour of ground.

Heat exchangers needed in your h-t water system to transfer heat to a lower-temperature fluid, cost about as much as pressure-reducing stations, high- and medium-pressure steam traps, condensate coolers, condensate-return tanks and pumps in a typical h-p steam system. Add cost of pits and trenches for steam systems to this list and chances are you've tipped the dollar balance in favor of h-t water.

Big advantage of h-t water is the closed circulation system. It cuts losses in heat-distribution circuits to a minimum. The table, top of page 77, gives the complete picture..

Properties of h-t water compared to steam also account for important advantages. Compare, for instance, one cu ft of h-t water cooled from 330 F (at 90 psig) to 212 F with 1 cu ft of steam cooled at the same pressure. Include steam condensate cooling to 212 F. H-t water yields 6100 Btu. Steam, including latent heat of vaporization, yields only 236 Btu. Thus a h-t water system has roughly 25 times the heat-storage capacity, on a volume basis, of a h-p steam system of equal rating at the same operating temperature and pressure. *Result:* You get ability to absorb demand fluctuations—a highly valuable asset for space and process heating.

Earlier we mentioned possible repair and maintenance savings of about 75%. You're likely to reap these savings because (1) h-t water system design eliminates much of the equipment subject to routine maintenance, repair (2) closed-loop water circuits tend to be noncorrosive. Oxidation and scaling are reduced to a minimum.

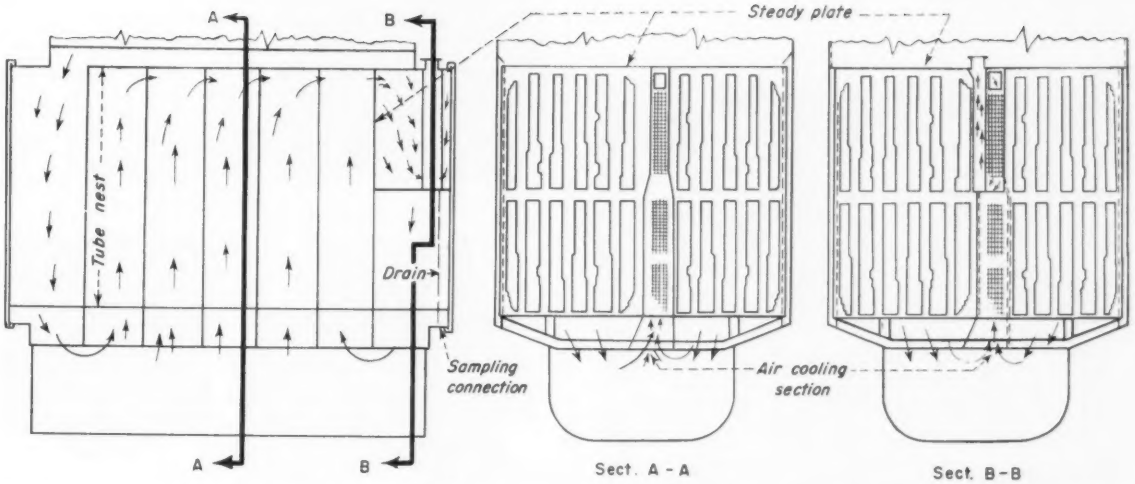
Operating safety. Small breaks or leaks in a h-t water line are not as dangerous as in a h-p steam line. If you do get a break in a h-t water system, pressure release allows hot water to flash directly to steam. Rapid expansion produces a refrigerating action much like that in a steam-jet refrigerator. It's even possible to hold your hand about a foot from an open small valve on a 375-F h-t water line without danger of getting burned. But *don't* try this trick on a 125-psig steam line!

Next month we'll show how to design a typical h-t water system.

How high-pressure steam, high-temperature water distribution systems compare*

Steam	18 in.
Condensate	6 to 8 in.
Drip line	2 in.
H-t water flow	10 in.
H-t water return	10 in.

*Pipe sizes are based on pipe carrying capacity of 150-million Btu per hr. Equivalent length of pipeline, 10,000 ft. H-p steam system: 125-psig boiler pressure; 50-psi allowable transmission pressure drop. H-t water system: 400-F flow temperature; 200-F return temperature; 10 ft per 1000 ft allowable friction head loss.



1 Ammonia, one of noncondensable gases, builds up in concentration as mixed gases approach air offtake, *upper right of longitudinal cross section.* Stainless steel tubes or bimetallic tubes at offtake resist corrosive effects of NH_3

Using once-through boilers at either sub or supercritical pressures in power-plant cycles raises special problems which demand that the designer make . . .

By **O A HAAS,** *Manager, and*
R A WILSON, *Consulting Engineer,*
Heat transfer and water conditioning section,
Allis-Chalmers Manufacturing Co

Condensers match once-through boilers

► ONCE-THROUGH or flash boilers (using no steam and water separating drums), producing steam at subcritical conditions, have been used fairly widely during the past 50 years in Europe. We designed and built our own flash boiler in 1943 for our test pits. The unit generates 12,000 lb steam per hr at 1200 psig and 1000 F and we still use it today.

Only the once-through boiler can generate steam at conditions higher than the critical, 3206 psia and 705 F. For lower steam conditions, the builders claim the boiler offers strong economic advantages.

Once-through boiler, made up of parallel continuous tubes, takes in pressurized feedwater at one end. Flowing through the tubes, feedwater absorbs heat and leaves as superheated steam. Because the water evaporates to complete dryness in one pass through the boiler, any solids in the water might tend to deposit on the heating surfaces. In a conventional boiler, they would concentrate in a separating drum.

Experience, to date, seems to indicate that at higher pressures and temperatures the zone of deposition may be moved away from the boiler to some lower pressure area. If so, the solids may deposit on turbine blades or even on condenser tubes. Any deposits that may cause boiler-tube burnouts or decreased turbine efficiency must be avoided by (1) eliminating all solids through feedwater conditioning (2) preventing leakage into the cycle. Both of these needs must be seriously considered by the condenser designer.

Boiler operation. When starting a once-through boiler the turbine is first bypassed. A boiler of this type does not have a drum that can be used for storing water and steam until the steam is dry enough for turbine use. Condensate and treated feedwater are pumped through the system and bypass and returned to the condenser hotwell, usually through water separators or flash tanks before firing the boilers.

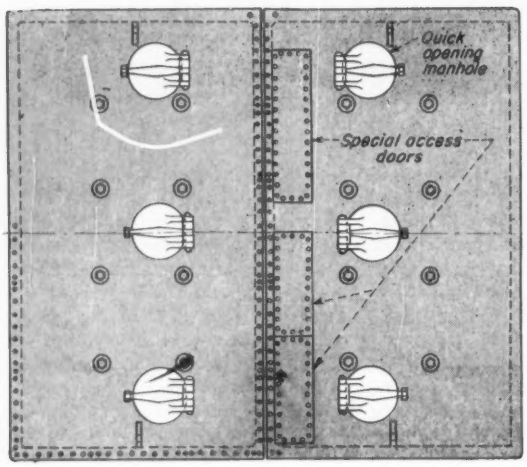
With water circulating, the fires are lighted. As temperature of steam leaving the boiler rises, spray water in the bypass cools the steam. Steam released by flashing in the water separators goes to a dump or cooler in the main condenser.

Gradual increase of the firing rate raises steam flow to about 30% of turbine rating. When temperature reaches proper level the automatic boiler control directs the steam through the turbine and shuts the bypass. When turbine loses load, or when boiler is being shut down for inspection, the automatic control discharges steam through the bypass into the steam dump in the condenser.

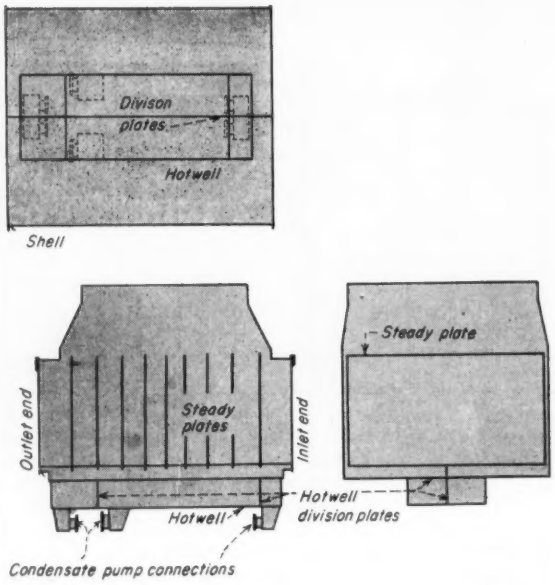
For normal load fluctuations, feedwater flow varies as needed and bypass stays closed. Desuperheating the steam during startup and shutdown operation adds to condenser design problems.

Feedwater conditioning must be used to attain purity levels needed by once-through boilers. In limiting iron pickup, ammonia or volatile amines must be used to control pH, regardless of demineralizers and filters used in the conditioning cycle. Hydrazine, which breaks down into ammonia, might also be used as a chemical scavenger to remove oxygen even though a deaerator would be part of the plant.

To prevent contamination and buildup of solids in the cycle, all leakage in the system must be held to a minimum. This means sealing between the



2 Special access doors in waterbox covers of condenser make it easy to replace corroded tubes in air-cooler section



3 Dividing condenser hotwell into compartments with baffles makes it easier to detect locations of leaks, fix quickly

Condenser design must aid solids control by preventing

circulating-water side and condensate side of the condenser must be exceptionally tight. So we must study the possible effects of water conditioning and leakage on condenser design.

Water conditioning effects. Free ammonia, or ammonia from breakdown of amines or hydrazine, attacks copper and copper alloys normally used in tubes and tube sheets of steam surface condensers. As ammonia passes through the condenser its concentration builds to a maximum in the air off-take sections. Here ammonia severely attacks the copper.

This suggests that condensers using copper-alloy tubes should have a minimum number of tubes in the air-cooling section. The section, however, must be large enough to insure proper air cooling and removal, with the tubes accessible for servicing. To do this, we place the air-cooling section lengthwise in the center portion of the condenser and remove the noncondensables at the top and end of the shell, Fig. 1.

This arrangement reduces the number of tubes in the air-cooling section; these can be easily serviced through the access doors in the waterbox cover plates, Fig. 2. This design may be used to reduce the added cost if stainless steel or bimetallic tubes are preferred in the air-cooling section.

Aluminum tubes resist ammonia attack. At this time, only a few condensers actually use aluminum tubes. These offer little data on which to judge comparative performance over a long period. With others we have done considerable research that indicates definite possibilities for aluminum under certain operating conditions: (1) decidedly lower first cost and (2) high resistance to ammonia attack.

Tube-sheet design. Where rolling tubes into single tube sheets at each end of the condenser will not entirely prevent leakage and contamination of the condensate the double tube-sheet design may be used, Fig. 4. This uses two tube sheets at each end spaced about 1½ in. apart. Space between tube sheets may be filled with pressurized inert gas to prevent circulating water leakage into either the sealing space or steam space.

In assembling condenser, tubes are first rolled in the inner tube sheets. Then, entire shell between inner tube sheets is tested with an inert gas to check leakage. Finally, tubes are rolled in the outer tube sheets. Pressurizing the sealing gas space between tube sheets helps locate leaks in outside tube sheets.

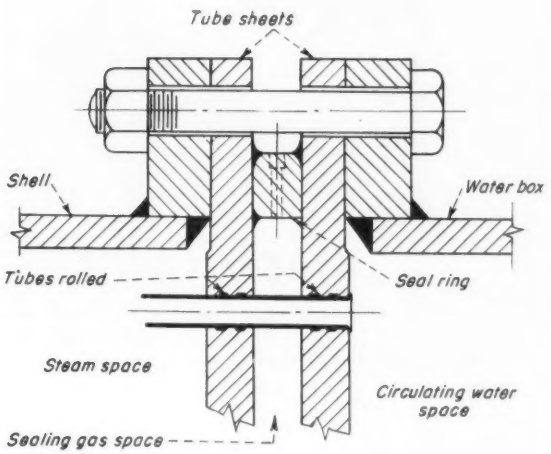
Still another design, to prevent inleakage of raw water, welds the tubes to the tube sheets, Fig. 5. Materials for the tubes and tube sheets must be chosen carefully to achieve satisfactory welds. We have pursued an extensive development program on this design; working out manual methods of fusing tubes to tube sheets with the heliarc method. This uses a thoriated tungsten electrode with argon as a shielding gas.

In more than 100 tests of various combinations of sheet and tube materials, we worked out welding methods for admiralty tubes and naval brass sheets, and for naval brass sheets with aluminum brass tubes. We also find that the more expensive silicon bronze tube sheets can also be welded to these alloys. These tube sheets, however, are not yet available in larger sizes. Although other combinations of tube and tube-sheet alloys can be welded, we don't believe standard leaded muntz metal should be considered at this time.

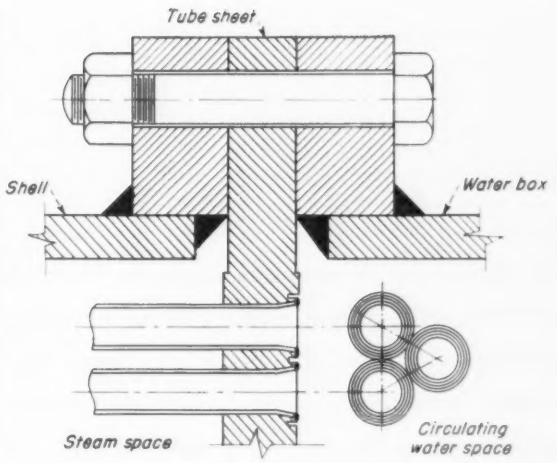
Having established compatibility of materials, we have had under development for some time an automatic gun-type tool for welding. It seems this automatic process will be comparatively simple and generally available in the near future.

Grooving in the tube sheet, Fig. 5, provides a lip about as thick as the tube wall so that two sections of about the same thickness are fused together. The groove around the tube limits the current needed for the weld, reduces the heat generated, and so the possible distortion of the tube sheet. We do not feel that possibility of distortion of tube sheets on large units can be overlooked at this development stage.

Welding tubes to tube sheets will be more costly than expanding tubes into



4 Double tube sheets in condenser prevent circulating water mixing with condensate and help speed up leak detection



5 Welding tubes into tube sheets needs special preparaion on circulating-water side; present design may be rostly

contaminating leakage

tube sheets. Material and labor cost on all weldable tube-sheet material will be more than on standard leaded muntz metal; naval brass shows the lowest cost differential and silicon bronze the greatest.

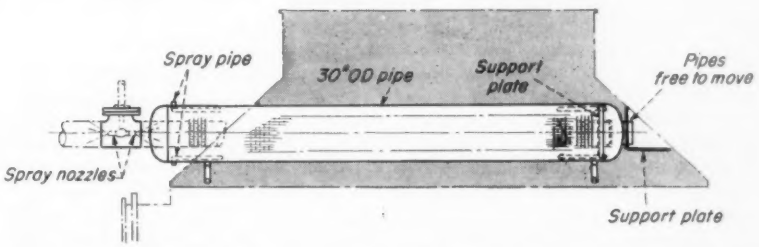
Cost of the argon gas used for shielding will, at present, exceed cost of expanding the tubes. Helium shielding gas may possibly reduce these costs, but it has been hard to get at times. After 25 years of development, tube expanding has become a simple process. We believe welding techniques will develop similarly; cost reductions being achieved with improvements in the art.

Sectionalized hotwells. For single tube sheets the most likely place for raw-water inleakage will be the joints between tubes and tube sheets. Sectionalizing the hotwell into three or more compartments with crosswise baffles, Fig. 3, for nondivided-waterbox condensers will speed up leak detection. For divided-waterbox condensers an additional baffle parallels the tubes for their full length.

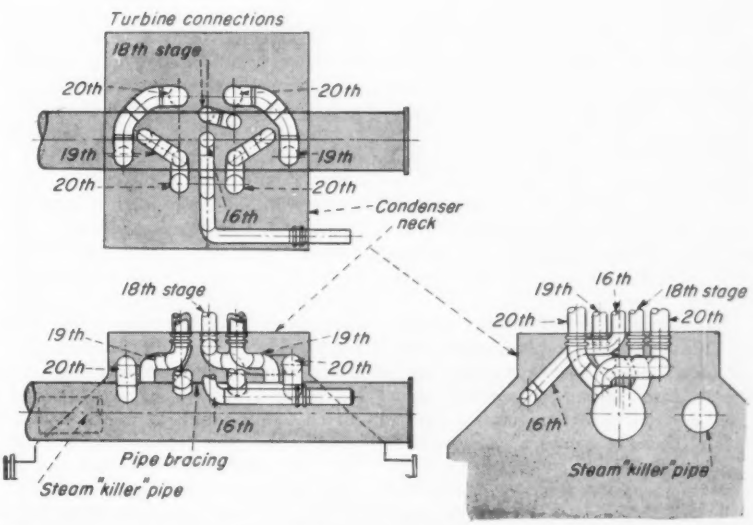
This layout allows sampling the condensate in each hotwell section for impurities. Any section showing higher solids concentration could be connected directly through the demineralizer before sending its condensate back to the boiler.

With the single tube-sheet design we have often sprayed the tube sheet at

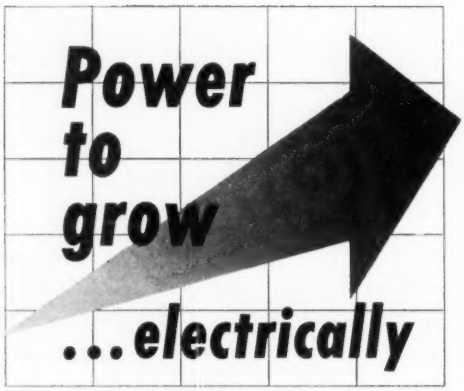
(*Continued on page* 198)



6 Steam dump assembly in condenser neckpiece consists of concentric inner and outer pipes perforated to give two-step pressure reduction to condenser pressure



7 Congestion of bleed steam piping, low-pressure heater shells and steam dump in condenser neck may soon demand that designers locate the first two elsewhere



NO. 5: FAULT CURRENTS

A successful PTG program hinges on knowing present fault-current values and exploring changes that may come tomorrow. Aside from actual calculations are the principles involved plus knowing the protective gear at hand for solving high s-c current problems

Short-circuit values: A sound base for

► IN DIGGING INTO the different aspects of PTG, the matter of management people understanding fault currents frequently comes to the fore. Especially so in smaller plants where management must have some understanding of the problem before they will go along with any long-range electrical program.

Increasing importance of the fault-current problem comes about with expanded use of electric power throughout industry. Remember, even the best designed system can expect to face up to a serious short circuit at sometime. When that occurs, your overcurrent protective scheme must operate with minimum damage to equipment while minimizing plant shutdown time. To do this the circuit breakers and fuses you select must be chosen in light of the largest currents that may flow through them. Likewise, other parts of the system, such as cables and switches, must be so designed to withstand the thermal and mechanical stresses that come about from the high values of short-circuit current.

Fault-current sources are not limited to utility feed or the plant generators. Actually, current flowing during a fault comes from two basic sources; synchronous and induction rotating equipment. These machines may be operating as generators, motors or synchronous condensers. Keep in mind, the value of fault current is limited by impedance of circuits and equipment right from source to point of fault. Also, each of the rotating machines mentioned produces fault currents decreasing with time since they have a variable reactance in the face of fault currents.

Calculating fault currents is simply an application of Ohm's law where the fault current is equal to the normal system voltage at the point of fault divided by the total impedance from source to fault. The bigness of many industrial plants today makes the conventional long-hand approach to short-circuit calculations most impractical. In such plants it's becoming increasingly popular to use facilities of calculating boards located at key points throughout the country. But whether you use long-hand or calculating board, a bird's-eye view of calculating procedures and source of fault currents is of top importance.

Fault types drop into three basic classes: full 3-phase fault, line-to-line fault and line-to-neutral fault. For practical purposes you are interested in the maximum current that may flow on any type fault. With this in mind, the 3-phase fault is generally the only one considered since it's this type fault that generally results in maximum current flow. Actually, the line-to-line fault currents run some 87% of the 3-phase value while the line-to-ground value may rise, under specific conditions, as high as 125% of the 3-phase value.

Using the full 3-phase fault as basis for calculations simplifies the job since fault remains symmetrical about the neutral point whether grounded or ungrounded. Even though faults occurring in the plant involve arc impedance, calculations disregard any such impedance effect, treating the condition as a bolted fault.

Voltage used for fault calculations is rated line-to-neutral voltage of either transformer or generator feeding into fault. As pointed out in the recently published AIEE book *Electric Power Distribution for Industrial Plants* ($3.50 per copy, available from American Institute of Electrical Engineers, 33 W 39th St, New York 18, N. Y.) the reactance of major elements, such as generators and transformers, is generally at least five times the resistance. In ac circuits impedance is the vector sum of resistance and reactance.

However the fault current, calculated by neglecting resistance of major elements and using only reactance, will be in error by but a few percent. Since this error is on the safe side, streamlined calculations today call for neglecting resistance of generators, transformers, motors, reactors and large bus work, regardless of system voltage.

Above 600 volts even the resistance of other circuit elements, such as cables and loops, is generally neglected. However, below 600 v consider resistance carefully when calculating faults out on branch circuit feeders. Conductor resistance is most important in low-voltage branch circuits where wire size is small. A rule-of-thumb: If resistance

Value of a PTG index

By tagging the installed capacity as unity, the PTG index gives some measure of a system's expansibility. Since PTG concerns itself with providing for growth, the major ingredient is planning. We define the PTG area as the planned-for-capacity that can be economically provided and integrated into an existing system. Planned power-to-grow capacity divided by installed capacity is what we call the PTG index.

Specific value best suited for your plant is something for you to decide based on your intimate knowledge of the industry, growth potential. The index then serves as a convenient yardstick for the system designer.

PTG planning

of low-voltage feeder circuit is ¼ or more the total reactance from source to fault, include resistance in calculations. In such cases also include resistance of system up to the feeder and an approximate total resistance equal to ¼ the total reactance of the system from source to feeder. Using this value of total equivalent resistance R, and the total equivalent reactance X, impedance to fault is found from:

$$Z = \sqrt{R^2 + X^2}$$

Include reactance of all circuit elements when calculating fault currents on low-voltage systems. In systems below 600 v, the importance of small elements of reactance in the limiting of fault currents becomes quite significant.

Full treatment on calculating short-circuit currents will not be included here. We're simply pointing out the major items that must be considered. The specifics of handling any case is well covered in textbooks and recognized handbooks (viz: *Industrial Power Systems Handbook* by D L Beeman, published by McGraw-Hill Book Co and the AIEE *Power Distribution for Industrial Plants* referred to previously.

Manufacturers of circuit-breaker equipment quite naturally have been playing a leading role in emphasizing the importance of careful fault-current calculations. In addition they have made sizable contributions to product improvement while jointly applying revised interrupting-capacity (IC) rat-

Where do fault currents come from?

When a fault occurs in an industrial system the resulting current flow stems from but two possible sources: synchronous and induction rotating euipment. And they can be motors or synchronous condensers as well as generators. Current in amperes that each such machine can deliver to the main circuit breaker in machine leads is limited by machine impedance. There is another common characteristic of each such machine: Resulting fault current will decrease with time once the fault is established. Machines display a variable reactance in the face of fault current.

Plant motors are too often overlooked as fault-current sources. Actually, synchronous motors supply current to a fault in much the same manner as synchronous generators. When a fault occurs, motor slows down and stops taking power from main source. However, since dc field excitation is still being applied, the unit operates as a generator and pumps power into the fault. The prime motivating force is the inertia of motor and its load.

Induction motors feed in a sizable chunk of short-circuit power to a fault. But since the field excitation here depends on applied ac voltage, the flux decays rather rapidly. So the induction-motor contribution, unlike that of the synchronous motor, drops off completely within a few cycles. For all practical purposes, figure the fault current contribution of an induction motor as being about equal to the motor's full-voltage starting current.

Plant generators and the incoming utility feeder are first thought of as fault-current sources. In considering the generator, whether it be within the plant or back in the central station, the fault current it supplies drops off from a relatively high starting point to a lower steady-state value sometime after the fault occurs. Unlike the synchronous motor, a generator continues to be driven by its prime mover after the fault is established and field remains on. So the steady-state current value persists unless the circuit breaker trips in the generator leads.

Generator reactance values, for fault-current analysis, falls into three classifications: *subtransient*, *transient* and *synchronous reactance*. The first, subtransient reactance, determines the current flow during the first cycle after the fault strikes. In a 60-cycle system, value of the fault current decreases during the first six cycles since the reactance value increases from a subtransient to a transient value. Then, in a period somewhere between 30 and 120 cycles (on a 60-cycle system), transient reactance gives way to the synchronous reactance. This latter reactance value determines current flow after a steady-state condition is reached.

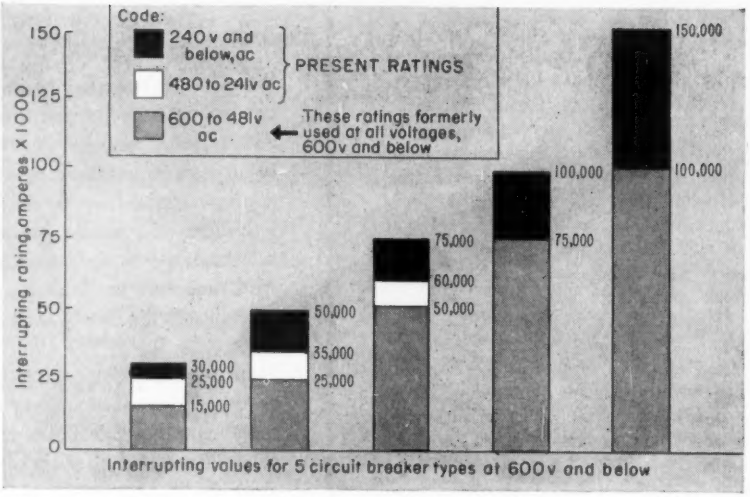
Field practice in fault calculations finds little use for synchronous reactance in the application of protective devices. Reasons being that most circuit breakers and fuses will operate before steady-state conditions are reached.

In any discussion of fault currents, keep in mind that the *magnetic stresses* circuit equipment must stand are a function of actual "let-through" current squared. *Thermal stresses* or equipment heating depends on let-through current squared multiplied by clearing time. Tie these thoughts to sketch, p 85, relating to current limiting.

A look at breaker ratings

Circuit-breaker manufacturers have for years been scrutinizing the feasibility of increasing IC ratings for large low-voltage air circuit breakers when applied at 208 and 440 v. (POWER, April 1955, pp 96-97). In the spring of 1955, circuit-breaker makers announced revised ratings for breakers used at lower voltages, chart, right. This move adds up to a tidy possible savings for users and plays a major role in selecting breakers for any PTG program.

Since there was no fundamental change in the breakers involved, what about allowable IC rating on breakers now installed? Where breaker is the same type as those now being sold, uprating might be OK. But, before deciding, check with the manufacturer.



Low-voltage air circuit breakers teamed with silver-sand fuses prove one answer to IC problems

ings to their products when the combined knowledge of fault interruption and product limitations so indicated.

Case in point occurred in March 1955 when manufacturers announced a boost of 50% in IC on some large low-voltage circuit breakers (POWER, April 1955, pp 96-97). This significant move came about as a NEMA activity. They had long been considering higher interrupting ratings for large 600-v air circuit breakers when latter are applied at 240 and 480 v. Prior to this time, the IC rating leveled for 600 v was the recommended value to use at 240 and 480 v. Results are shown in bar-chart above. This places one more economic tool in the electrical engineers hand to lay out a scheme that would successfully cope with the growing problem of fault currents at reasonable cost.

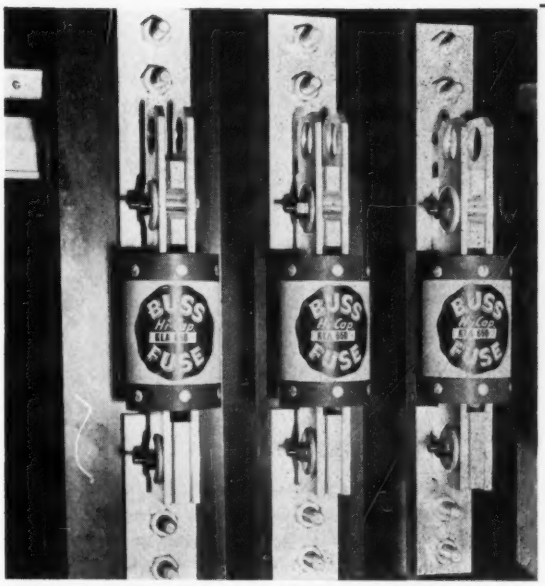
Current-limiting fuses are making their mark in the area of fault-current interruption. But in too many instances, the silver-sand current-limiting fuse is used as an attempted cure for poor engineering. In exploring this phase, POWER asked J C Lebens, Vice President in Charge of Engineering, Bussmann Mfg Co, to outline his thinking on the growing problem of misapplication of silver-sand fuses. Following are the highlights of his comments:

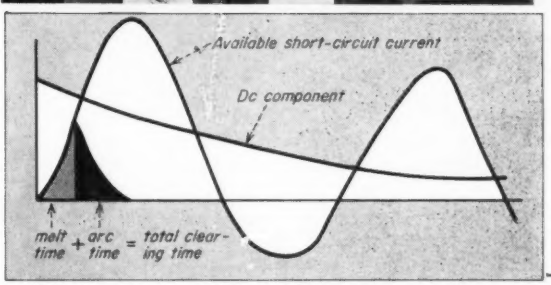
Existing systems, now unsafe because of increased available currents, can be protected by silver-sand fuses of proper rating. Also, new systems can be protected by the same fuses in conjunction with other forms of protection. Unfortunately, the glamour of cutting off short-circuit currents before they develop has so enthralled some engineers that they assume the silver-sand fuse is the answer to their every problem and select it accordingly. Silver-sand fuses can only furnish short-circuit protection. And this short-circuit protection is obtained at the expense of other desirable features which might dictate selection of some other type of electrical protection.

Current-limiting silver-sand fuses are available in ratings from 1 to 6000 amp at 600 v or less. Ratings of 600 amp or less are designed to fit into standard fuse holders while the larger sizes are usually bolted into the circuit.

A fault is a relative term. Any overload continued long enough to damage the circuit or its components is a fault. Distinction between a harmless overload and a fault is a matter of time, at any value of current. Hence, to permit operating a circuit at its full capacity, silver-sand fuse size must be selected large enough to permit useful overloads to flow without blowing. *Example:* Circuit having a 100-amp motor load can be protected by a 100-amp dual-element fuse. This fuse permits the motor to start and come up to speed. However a 100-amp silver-sand fuse on this same 100-amp circuit would blow each time motor tried to start, no matter how lightly loaded. In fact, a 300-amp silver-sand fuse would be needed if full circuit capacity is to be realized. And then some form of additional protection must be used to protect the circuit between 100 and 300 amp. This might well be a circuit breaker, another fuse, an overload relay or motor starter. But the silver-sand fuse alone gives only short-circuit protection.

In many cases short-circuit protec-





Role of the silver-sand fuse

A generation or so back, the fuse vs circuit breaker question popped up quite often. In recent years, however, the fuse has moved into the major league in the low-voltage field. Back of this move is the so-called current-limiting fuse. It uses a silver element surrounded by silica, has current-limiting abilities in line with the needs found in modern plants. Its chief boast is that it will interrupt a short circuit before current reaches the dangerous values possible.

The silver-sand fuse is a tube with silver elements in silica filler. Silver is used because: (1) Conductivity is not impaired by continuous operation or current surges yielding temperatures slightly under the melting point. (2) Having low specific heat, silver can be raised to the vaporization point faster. (3) Its vaporization temperature is much below the temperature at which vapor readily ionizes.

Although the silver-sand fuse is fitting a major need in industry, all too often it is misapplied. **J C Lebens**, VP of Bussmann Mfg Co, outlines below just where this class fuse fits into a PTG program.

tion furnished by a silver-sand fuse is sufficient justification for its use. *Example*: A large industrial plant found transformer changes increased available short-circuit currents on the system from 20,000 to 40,000 amp. The 20,000 amp could be handled safely by the installed circuit-breakers having an interrupting capacity of 25,000 amp. But the higher available figure might cause the breakers to blow up if called upon to clear the maximum fault.

In this case the answer was to split the bus and install silver-sand fuses of proper rating. Then short-circuit currents greater than 25,000 amp could not flow, even under the worst fault condition. Here the fuse was used properly for short-circuit protection only and its rating selected on that basis.

How to select. To make sure a silver-sand fuse is properly sized, get the following data:

1. Circuit-breaker maximum and minimum characteristic curve.
2. Circuit-breaker interrupting capacity.
3. Fuse time-current characteristic.
4. Fuse current-limiting chart showing let-through current.
5. Maximum available symmetrical rms current.

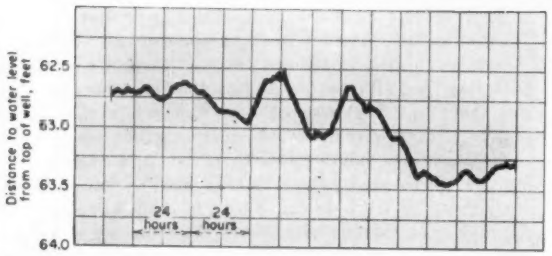
Point at which the fuse is to take over the interrupting duty is arbitrarily selected as 80% of the circuit-breaker interrupting capacity. Opening time of breaker at the take-over point is obtained from the circuit-breaker maximum and minimum characteristic curve. Fuse rating is then selected from its time-current characteristic so opening time is the same as that of the breaker at the take-over point (POWER, October 1953, p 107).

Instantaneous peak let-through current which fuse permits (under specific fault conditions necessary to produce the maximum available symmetrical rms current) is obtained from fuse current-limiting chart showing let-through current. (ED NOTE: This chart is available from manufacturers of silver-sand fuses). Since the circuit-breaker is capable of withstanding a peak let-through current equal to twice its interrupting rating, the let-through current of the current-limiting fuse selected must be less than this value.

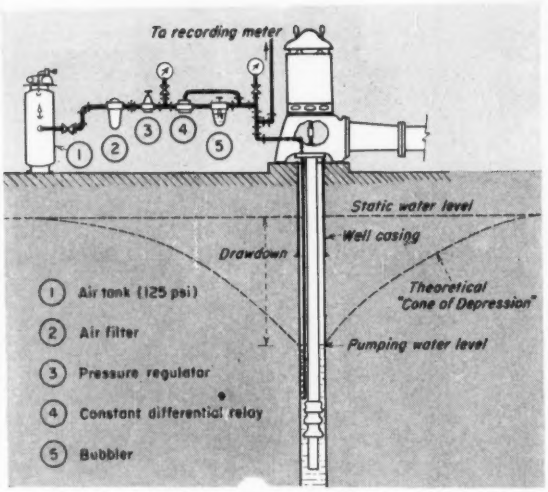
Having selected a fuse satisfying both the take-over point on time-current characteristic and instantaneous peak let-through current requirement, selectivity of fuse-breaker combination over the entire range is next step to pin down. Check this by plotting fuse time-current characteristic and the circuit-breaker maximum and minimum characteristic curve. For proper selectivity at all current values up to the take-over point, fuse opening time must be greater than maximum opening time of breaker. For all current values greater than the take-over point, fuse opening time must be shorter than minimum breaker opening time. Determine this from characteristic curve.

If fuse opening time is less than maximum opening time of breaker at some current values less than take-over point, needless fuse blowing will result —but the combination is safe. However, if fuse opening time is larger than minimum opening time of breaker (at some value of current greater than take-over point) an unsafe condition results and (*Continued on page* 210)

By ROBERT N HOUSTON,
Lederle Laboratories Div, American Cyanamid Co



1 Static level of underground water varies as demands for well water rise and fall. Note changes in this one week



2 Pressure required to balance weight of water over end of the air line indicates height of water in pumping well

Should you drill another well near your plant?
Will changing ground water level affect pump operation?
Here's how to get the data that answers these questions

Check your ground-water level during pumping and static periods

► WHEN YOU KNOW the ground-water levels in your plant's well field, you can use the data to good advantage in (1) trouble shooting on well pumps (2) figuring pump efficiencies (3) determining whether the water-bearing strata is becoming silted up, requiring well development to restore the yield (4) general policing of water withdrawn from the well field.

Here's the meaning of ground-water level, plus information on how and when to check it.

Definitions. The term *ground water* means the underground water that is created and maintained by rain, snow, infiltration of water from rivers, lakes, treated-sewage effluent, etc. The level of underground water is by no means static. It fluctuates almost hourly within several miles of a well field.

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In a general way, a newly-drilled well has a static or standing water level even before it is pumped. This is called the original static level. When a pump is installed and started, water level drops according to the amount pumped. If the well is not overpumped, level stabilizes. This is called the pumping level. Difference between pumping and static levels is called drawdown.

When to check level. To find out how much fluctuation you have, check standing and stabilized water level (pumping level) at various flow rates for all new and operating wells in your plant.

After once checking this, set up a program to measure the pumping level weekly or monthly. Measure static level whenever wells are shut down for over 24 hours. Keep data accurately and consistently.

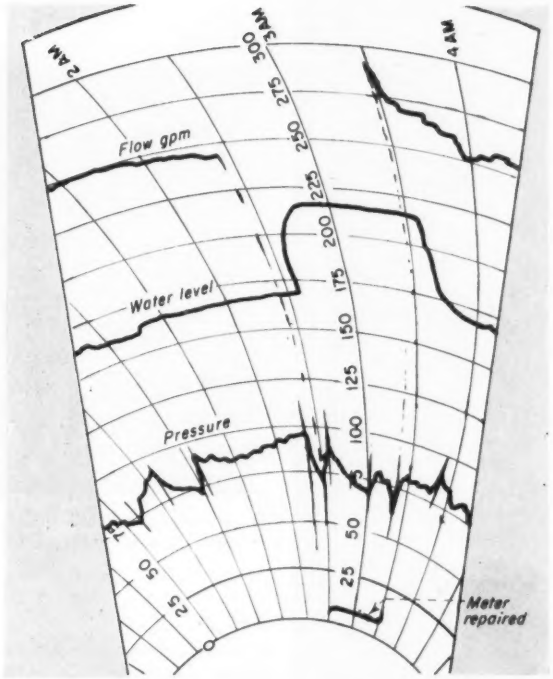
One way to conserve water and reduce well drawdown is to design new equipment and convert older equipment, where possible, to use recirculated water.

Static level. At our plant, there are 11 operating wells, with five *holes* that are not pumped for economic reasons. On one such well, at edge of the field, we installed an automatic recorder in 1952, in cooperation with the U.S. Geological Survey. This instrument requires no power to operate and gives a weekly continuous graph of the static ground-water level.

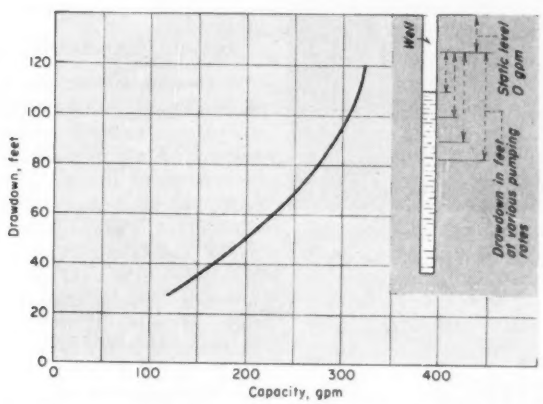
Although the graph shows static level in this particular well, it is influenced by pumping from the entire well field.

Thus, we know the static-water-level trends in the area of our plant from 1952 to the present. We also plot water production and rainfall.

Fig. 1 shows a weekly chart. You



3 Recording meter for pumping well shows flow, water level, discharge pressure; gives continuous performance record



4 Chart showing drawdown vs capacity is useful in checking water production from the well over a long period of time

can see when we had heaviest demand for well water by noting the lowering of static level. A considerable time lag is involved, however.

Pumping level. Besides keeping this graph, we also maintain an automatic water-level recording device on each pumping well. Fig. 2 shows a typical arrangement. An air compressor supplies a constant air purge to the air line. Pressure required to balance the height of water over the end of the air line is indicated on an altimeter gage with two scales; one reads directly in feet of water, the other in psi.

Height of water level over the end of the pipe is also recorded on the meter. This meter has three elements, measuring flow from the well in gpm, discharge pressure, and water level in the well. Fig. 3 shows a sample recording. Fig. 4 shows a graph of drawdown vs gpm. This graph can be used to check well production over a long period of time.

These charts let us observe pumping and static water levels. In addition, the air line provides extra pump protection. If pump draws more water than the well can yield, a mercury switch senses low pressure in the air line and shuts off the pump motor to prevent damage.

Air line. We have found that the usual arrangement of ¼-in. copper tube strapped to the pump column presents restriction problems when you have a continuous air purge. It's OK for intermittent water-level readings, but requires considerable maintenance because it crushes easily and must be replaced frequently.

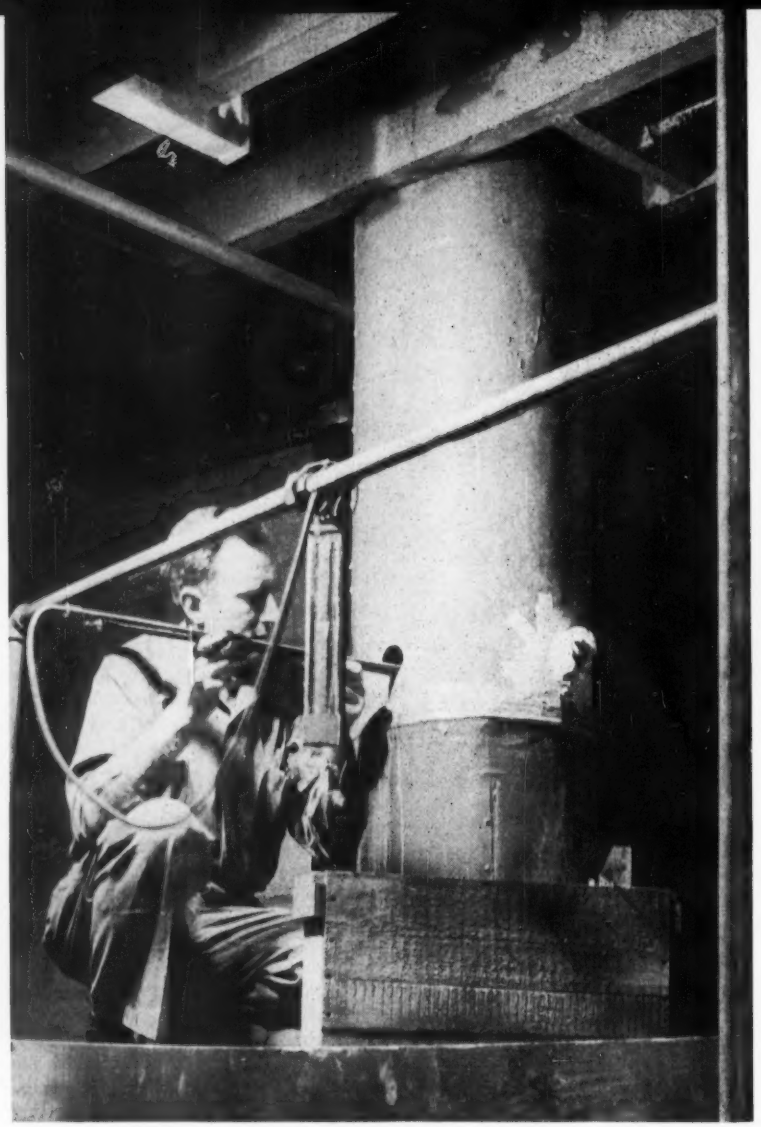
We have found best arrangement is to use a ¾ in.-galvanized or brass pipeline, with the first foot drilled with several 1/16 in. holes. This pipe must be supported firmly because it weighs several hundred pounds for an average depth well. An existing hole in the pump base can serve as a support if the pipe is suitably clamped. We have also used clips welded to the steel casing for supports.

Cost of automatically recording water level in the wells is about $100 per year per well, including depreciation, maintenance and operating expense. While this is not cheap, it must be thought of in terms of pump protection and engineering data obtained.

Other methods. There are two other methods of obtaining static and pumping water levels. These are not automatic. One method uses an air line installed in the well. Depth of the air line should equal the pump setting or distance down to the pump itself. A fitting that will receive an ordinary bicycle pump and a pressure gage are mounted on the air line. To find water level, pump up the line until air pressure becomes stabilized. Note the pressure in psi. This figure, multiplied by 2.31, gives the height of water in feet over the pump.

The other method uses a specially constructed electric sounder that is lowered into the well. When unit touches the water a bell rings or light flashes. The wire is marked at 5-ft intervals for easy figuring. Be careful that you are not fooled by a water stream cascading into the well.

Summary. After several months of consistent water-level observation you will note a pattern. The effort will be repaid when a problem in plant water supply comes up. Having such data will help your well drilling contractor or water consultant solve the problems mentioned above. In addition, you can sometimes solve or avoid pump problems by knowing the underground water table under varying conditions.

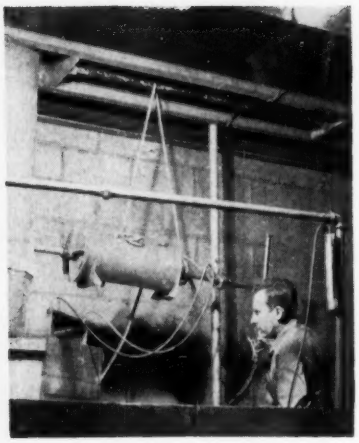


1 Pitot tube traverse of duct or stack gives gas velocity. Take measurements at 12 to 48 points depending on duct cross section and turbulence of flow

How to measure dust in stacks and ducts

Are your plant's dust collectors efficient? How much dust do your plant's stacks contribute to the atmosphere? Find out by following this simplified procedure

By C A GALLAER, *Asst Chief Engineer, Buell Engineering Co, Inc*



2 Sampler traverse, accurately done, gives a good measure of stack dust

► DETERMINING dust concentration involves measuring volume, temperature and pressure of the gas stream, as well as concentration of the solid particles or dust. Here's how Buell Engineering Co recommends doing the job.

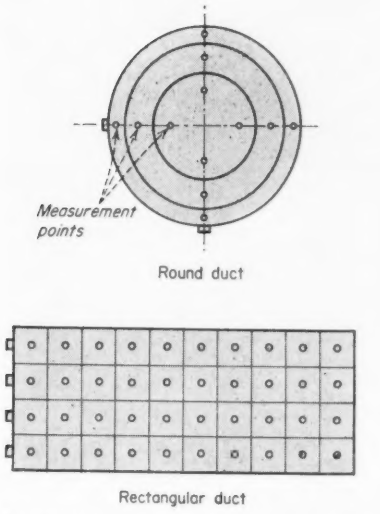
VOLUME, TEMPERATURE, PRESSURE

1. Locating test section: Volume rate of flow through a duct equals the product of cross-sectional area and average velocity. While it is simple to get the cross-sectional area by direct measurement, finding average gas velocity with a pitot tube is more delicate.

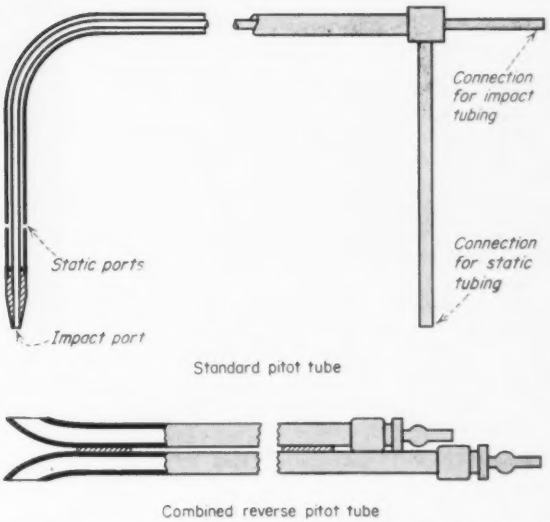
The pitot tube must be spotted in the best possible straight line flow, where turbulence is at a minimum. Theoretically, assuming a circular duct, there should be at least a five-diameter length before and a five-diameter length after the test point. If this is impossible, put the tube in the straightest available run of duct. To some degree, you can compensate for a poor location by increasing the number of test points.

2. Number of test points. Divide cross-sectional area at the test point into a number of sections of equal area. You can then assume that average gas velocity in the duct is the average of the velocity through each section. The velocity through each section is assumed to be equal to the velocity at a central point in that section.

Of course there are errors inherent in these assumptions. This is why you must choose a test section as free from turbulence as possible. To further reduce the chance of serious error, divide the cross-sectional area of the duct into as many sections as practicable.



3 Divide ducts into equal areas; take measurement at center of each area



4 Use a pitot tube to measure duct velocity; technique is the same for either; see text info on which to choose

The number of sections is best determined through experience. In general, use at least 12 test points. When the duct area is greater than about 25 sq ft, or under turbulent conditions, you may need as many as 48 points.

A square or rectangular duct is most easily divided into rectangular sections, while a round duct such as a stack is most easily divided into annular sections, Fig. 3.

3. Equipment to determine the gas velocity by a pitot tube traverse includes: standard or combined reverse-type pitot tube; inclined draft gage, accurate to .01 in. water; rubber tubing; thermometer or pyrometer; U-tube manometer, water or mercury, as required.

4. Procedure. Use either type pitot tube, Fig. 4. Usually, individual preference can determine the choice. But in heavily dust-laden gas streams, the small static ports on the standard tube may become plugged. This causes erroneous readings. On the other hand, the standard pitot tube is considered more accurate for normal use. The technique is the same for either tube.

Connect the pitot tube to the inclined draft gage by rubber tubing. Connect impact opening of the tube to gage's pressure side. Then check for leaks. Blow lightly into the impact opening and immediately pinch off the rubber hose close to the pitot tube. If liquid level in the gage does not fall there are no leaks in this tubing. Repeat the procedure for the static tubing.

Next, insert the pitot tube in the duct and position it at one of the predetermined testing points. Hold the tube steady and see that it points directly into the flow. Record the gage reading, move tube to the next point and continue until the traverse is completed.

To determine static pressure, remove the impact pressure connection and read the gage while the pitot tube is inserted in the duct. If reading is off the draft gage scale, use a U-tube.

To read static pressure with the combined reverse-type pitot tube, rotate tube 90 deg with the flow. Then error is negligible for all but the most precise measurements. With the standard tube you get true static pressure when tube points into the stream.

Measure temperature in the duct with a pyrometer or thermometer. In either case, when the duct is under a negative pressure, take care that cold air is not sucked in along the thermometer or thermocouple lead. Such air inleakage can cause an error of several hundred degrees.

In small ducts and those with a rather uniform flow, it is generally sufficient to measure temperature at one point in the cross section. But in large ducts (over 25 sq ft cross-sectional area) there may be a considerable variation caused by superheat controls, sectionalized air heaters, etc. Then it is best to make a temperature traverse of the same points used in the pitot-tube traverse to determine the average temperature.

5. Calculations. Pitot-tube formulas are derived from the basic flow equation:

$$(1)\ U = \sqrt{2gh}$$

After converting to more convenient units and supplying the necessary constants, we arrive at the following formulas:

(2) Standard pitot tube:

$$U = 1096.5\sqrt{\Delta P/S_1}$$

(3) Combined reverse tube:

$$U = 937.2\sqrt{\Delta P/S_1}$$

See table, p 91, for nomenclature.

The gas density at standard conditions (32 F and 29.92 in. Hg), S_o, may be obtained from tables or computed from the gas analysis. For air, S_o = .0807 lbs/cu ft. Density at duct conditions, S_1, is then computed from this formula:

$$(4)\ S_1 = S_o \times [492/(460 + T_1)] \times [(BP + P_1)/29.92]$$

Use (2) or (3) to compute average duct velocity, U_a. Take the square root of each value of ΔP obtained during the traverse and use the average of these square roots. It is absolutely wrong to average the values of ΔP and then use the square root of the average.

When you have the average duct velocity, compute the volume throughout by using formula (5):

$$(5)\ V = U_a \times A$$

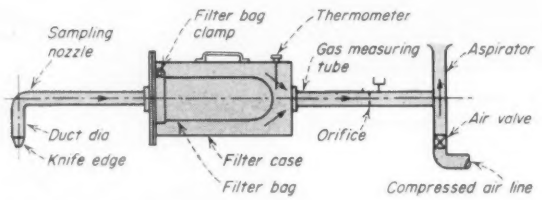
6. Other methods of determining volume. Sometimes, you can compute stack gas volume by a material balance method. *Example*: In a steam-boiler plant, if the weight of coal burned per hour and chemical composition of the coal, ash and stack gas is known, you can compute the weight (and hence the volume) of stack gas by balancing the weights of carbon into and out of the system. You can also apply this same principle to cement kilns and other process industries. But it is not

always possible to get the necessary material weights.

Many pieces of industrial equipment, like dust collectors, air heaters, economizers, etc, are calibrated by the manufacturer in respect to the pressure drop across the equipment for a specified volume throughout and temperature.

You can use pressure drop across the equipment to compute volume flow through it. In dust collectors, pressure drop is directly proportional to the square of the volume throughout, if temperature remains constant.

5 Sampler parts are simple but must be carefully made and assembled for good results. Beware of leaky connections



6 Dust sampler has wool, orlon or fiber glass filter bag; air valve setting controls gas flow through the sampler

MEASURING DUST CONCENTRATION

Theory. In obtaining a sample of dust from a gas stream, flow rate into entrance of the sampling nozzle must be about the same as velocity of gas passing the nozzle. Gas velocity entering the nozzle affects total quantity of solids and percentage of fines.

If velocity into the sampling nozzle exceeds velocity of the surrounding gas, some dust particles that would otherwise pass the nozzle are diverted from their normal path and carried into it. Since finer particles are more easily deflected, the percentage of fines in the sample will be too large. On the other hand, if velocity into the sampling nozzle is lower than that of surrounding gas, some gas is forced outside the sampling nozzle entrance area. This results in a higher dust concentration in the sample, with too low a percentage of fines.

Maintaining the same velocity within as without the sampling nozzle creates the least possible disturbance in the gas stream. Then quantity and quality of sample is characteristic of the total dust in the gas.

Sampling-nozzle location is just as critical as location of the pitot tube. So, except in unusual circumstances, use the same position for both pitot-tube traverse and for dust-sampling test.

The dust sampler consists of: filter case; gas measuring tube; aspirator; filter bag clamp; air valve; filter bags (fiber glass, orlon or wool). Sampler is assembled as shown in Fig. 6. Before assembling, dry and weigh the filter bag. See Step 7, below. You need this tare weight in later calculations. Fasten the filter-bag clamp tightly to prevent the bag from being blown loose during the test.

Additional equipment needed includes: (1) Sampling nozzle, made from standard pipe, ¾-to-1-in. nominal diameter. Use the smaller piping for the higher velocities. Usually, a 1-in. diameter pipe is satisfactory. (2) 600-F dial-type thermometer. (3) Pitot tube. (4) Inclined draft gage to read pressures up to 2 in. of water. (5) U-tube mercury manometer to read pressures up to 10 in. Hg. (6) Thermometer or pyrometer to determine duct temperature.

Here's how to make the test:

1. Select sampling location for minimum turbulence. As mentioned above, use the same criteria as for selecting the pitot-tube test section. To avoid errors caused by settled dust, choose a vertical flue, when possible.

2. Measure gas temperature. Take the precautions against air inleakage mentioned above.

3. Select sampling points in duct cross section. Use the same points as for the pitot-tube traverse.

4. Measure gas velocities. Use the pitot tube.

5. Calculate sampling rates. Velocity of gas entering sampling nozzle must equal velocity of gas in that portion of the duct. So volume of gas to be drawn through sampler at any point equals cross-sectional area of the nozzle times the gas velocity, or

$$(6)\ V_1 = U \times A_1$$

Measure volume of gas drawn through the sampler by differential pressure across the orifice in the gas-measuring tube. There is a temperature and pressure drop through the sampler, so this measured volume will be different from that just calculated.

Unfortunately, there is no way to determine pressure and temperature at the orifice before running the test. But experience in operating the sampler will let the operator predict it with sufficient accuracy. For the first test point, assume that temperature at orifice is about halfway between ambient and flue temperature; pressure drop is about 0.2 or 0.3 in. Hg. For future test points, assume that temperature and pressure are the same as at the previous point.

Having assumed these values, calculate volume of gas to be measured across the orifice:

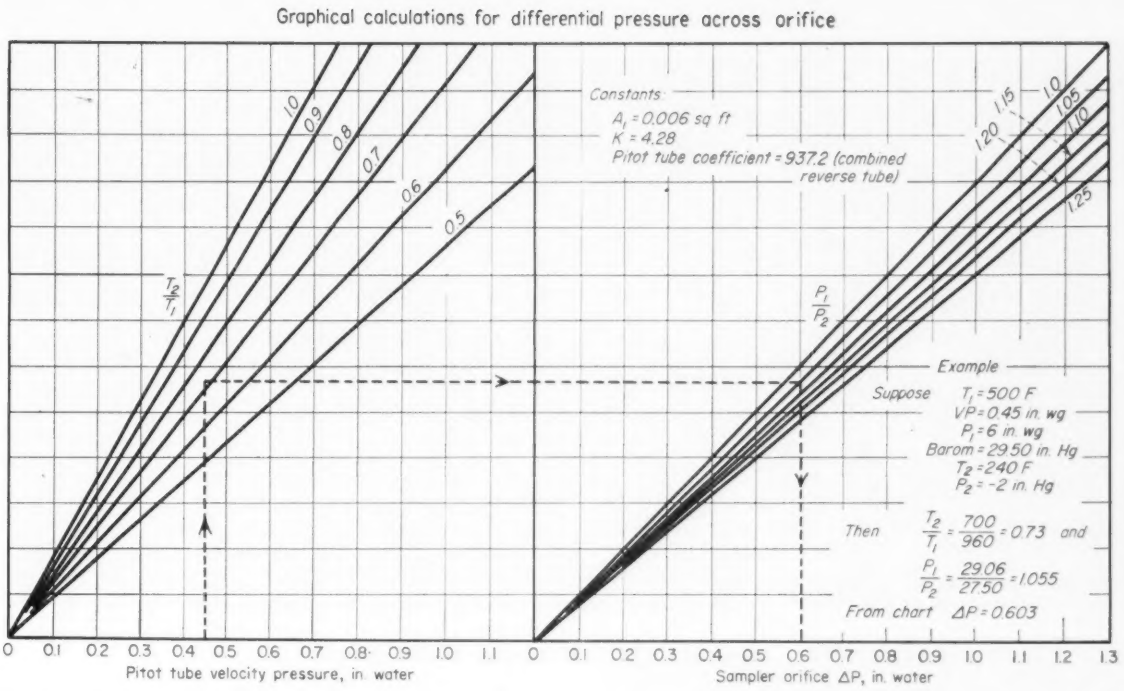
$$(7)\ V_2 = V_1 \times [(460 + T_2)]/(460 + T_1)] \times [(P_1 + BP)/(P_2 + BP)]$$

6. Predetermine orifice pressure differentials. Differential pressure across the orifice necessary to cause this volume of flow through the orifice is:

$$(8)\ \Delta P = S_2 \times (V_2/K)^2$$

If you are not used to sampler operation, calculate ΔP for several values of T_2 and P_2, so you will be able to maintain correct sampling-nozzle velocity during the test. Make up a chart for the given pitot tube and orifice constants to speed these computations. Fig. 7 shows a typical chart.

7. Sampling procedure. Insert nozzle in the duct, pointed into the gas


Graphical calculations for differential pressure across orifice
Constants
A_2 = 0.006 sq ft
K = 4.28
Pitot tube coefficient = 937.2 (combined reverse tube)
$\frac{T_2}{T_1}$
$\frac{P_1}{P_2}$
Example
Suppose T_1 = 500 F
VP = 0.45 in. wg
P_1 = 6 in. wg
Barom = 29.50 in. Hg
T_2 = 240 F
P_2 = -2 in. Hg
Then $\frac{T_2}{T_1} = \frac{700}{960} = 0.73$ and
$\frac{P_1}{P_2} = \frac{29.06}{27.50} = 1.055$
From chart ΔP = 0.603
Pitot tube velocity pressure, in. water
Sampler orifice ΔP, in. water

7 Chart helps you calculate differential pressure across orifice. This value affects flow through the sampler nozzle, hence determines how accurate the results are. Use pitot tube and orifice constants for your particular setup

stream and positioned at the first sampling point determined in Step 3. Use rubber tubing to connect the inclined draft gage to read differential pressure across the orifice. Connect the mercury U-tube manometer to read static pressure at the orifice discharge. Insert the dial-type thermometer in the filter-case thermometer well, and connect air line to the aspirator.

Open air valve slowly until ΔP reads the value calculated in step 6; note the exact time. Continue to sample at the first point for five minutes, then move nozzle to the second sampling point. If the dust concentration in the duct is very low, or if only a few sampling points have been selected, you may have to sample each point for 10 to 15 minutes to secure a sufficiently large sample.

Read and record values of T_2 and P_2 twice for each sampling point. Adjust air valve constantly during the test to maintain ΔP at the value calculated in Step 6 that corresponds to T_2 and P_2 as read from the instruments.

Continue until you have sampled all points for the required time. Then turn off air valve and remove sampler from the duct. Keep nozzle end of the filter case higher than the aspirator end.

When duct is under a negative pressure, cork the open end of aspirator and, at the same time, shut off air supply. This prevents possibility of a reverse flow of air carrying part of the dust sample out of the bag, back into the duct.

Next, remove filter bag. Weigh it and the dust; tare weight of the bag was obtained before the test. To eliminate effect of absorbed moisture from the calculation, thoroughly dry filter bag at about 200 F for several hours before weighing, when obtaining both tare weight and gross weight.

8. Calculations. Obtain average of the pressure and temperature readings and average of the square roots of the differential pressure across the orifice.

Calculate density, S_2, of the gas passing orifice at the average values of T_2 and P_2:

(9) $S_2 = S_o \times [492/(460 + T_2)] \times [(BP + P_2)/29.92]$

Next, figure volume of gas actually passing through the orifice, V_2:

(10) $V_2 = K \times \sqrt{\Delta P/S_2}$

Convert this volume to the volume of gas flowing into the nozzle at duct conditions of temperature and pressure:

(11) $V_1 = V_2 \times [(460 + T_1)/(460 + T_2)] \times [(P_2 + BP)/(P_1 + BP)]$

Total volume of gas sampled, Q, is:

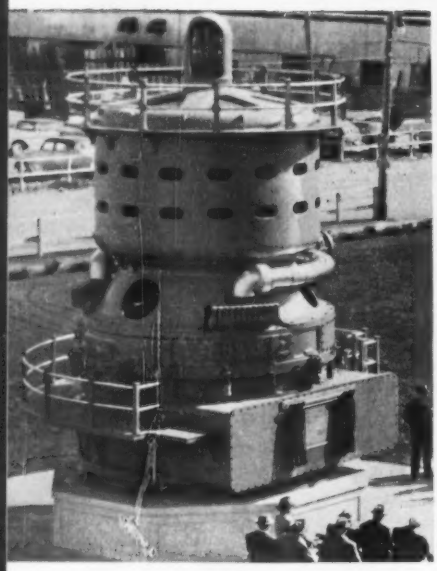
(12) $Q = V_1 \times$ elapsed time of test, min.

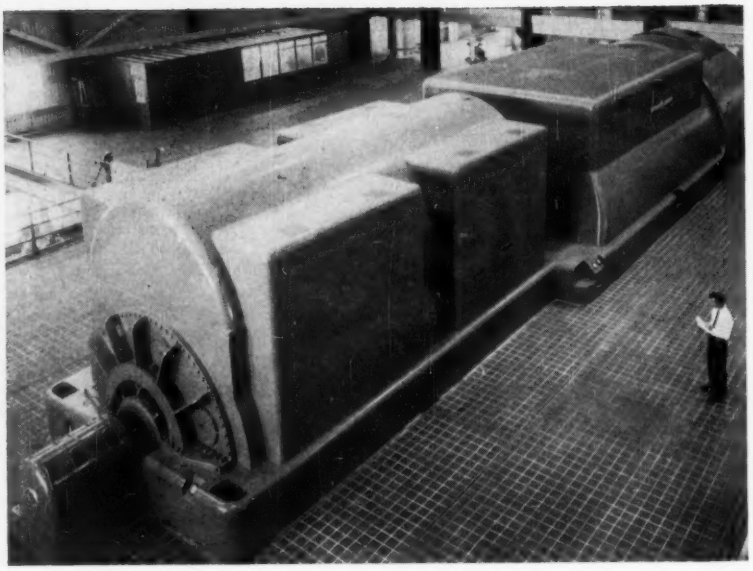
Dust concentration in grains per cu ft, is:

(13) Dust concentration $= (W \times 15.435)/Q$

Nomenclature for dust concentration tests

A = cross-sectional area of duct, sq ft
A_1 = nozzle area, sq ft
A_2 = orifice area, sq ft
BP = barometric pressure, in. Hg
C = orifice discharge coefficient
K = 1096.5xCxA_2, a constant
ΔP = differential pressure, in. water
P_1 = duct static pressure, in. Hg
P_2 = static pressure at orifice discharge, in. Hg
Q = total volume of gas sampled, cu ft
S_o = gas density at standard conditions, (32 F and 29.92 in. Hg)
S_1 = gas density at duct conditions, lb per cu ft
S_2 = gas density at P_2 and T_2, lb per cu ft
T_1 = duct temperature, F
T_2 = temperature at orifice, F
U = duct velocity, fpm
U_a = average duct velocity, fpm
V = gas volume, cfm
V_1 = volume to be sampled, at duct conditions, cfm
V_2 = volume at orifice conditions, cfm
W = weight of dust sampled, grams





World's biggest in 1903 . . . **Dwarfed by 1957's liquid-cooled giant . . .**

Typifies the electrical industry's seven-league strides in its effort to deliver . . .

More power to you

► A LITTLE MORE than a half-century ago, a group of men stood in a smallish building in Schenectady, N. Y. nervously eyeing a machine that stood four times as high as a man.

The building was the General Electric Co's test shop and the machine was the result of a change in design of steam-driven turbine-generators. A change so radical that there was doubt it would work—even among some persons at General Electric. As for being nervous, the group knew that the Commonwealth Edison Co had designed a generating station in Chicago expressly for this machine. Upcoming factory test could mean triumph or tragedy.

It's history that the machine fulfilled the convictions of the men who designed and built it. It's history, too, that in a few years it was too small to supply the demand for electrical power and was overshadowed by a bigger machine. But its significance, its impact on electrical generation practice, was too great to let it sink into oblivion. Returned to its birthplace, the machine recently was mounted in GE's Turbine Park as an "inspiration for the future."

Even while the dedication ceremonies were in progress, one of the machine's direct descendants, photo, top right, had joined the ever-increasing number of great steam turbines that are producing nearly three-fourths of the nation's electricity.

This modern giant represents another first by having liquid-cooled conductor bars in the generator stator. Rated at 260,000 kva, it's driven by a tandem-compound reheat turbine. With liquid coolant, the generator can produce 75% more kva than a conventionally-cooled generator of similar dimensions.

In the 50-odd years since the 5000-kw unit went to work in Chicago, America's electrical demand has been little short of phenomenal. To supply it, America's engineers have teamed up to build ever-bigger, ever more efficient generating equipment.

Today, in hundreds of power stations, hurricanes of steam are blowing. Super hurricanes in fact, because the top reading on the storm gage is about 120 mph while the man-made tempests rage at speeds up to 700 mph. In these blasts spin the turbines, the muscle that drives the mighty generator on the same shaft. And in less time than it takes to tell it, the electricity is miles away, running a stoker motor, lighting a hospital operating room, exercising tight control of a complex process.

These generating stations are the answer to a challenge from, and a tribute to, American industry. Demand runs the scale from an electric mousetrap to a 80,000-hp motor. Not only have American engineers shifted the country's heavy labor to the generator's steel shoulders, they've produced a thousand and one electric-powered items for America's comfort and luxury.

In 1900, total installed generating capacity was about 2 million kw. Compare this with a recent weekly survey that showed a total consumption of 12 *billion* kwh. Electrical industry people freely predict this figure will double in less than ten years.

Regardless of predictions, you can be sure of one thing: As your industry expands and your electrical power needs grow, the electrical industry will be geared to deliver more power to you.

Update lighting before vacating an old building

By DOUGLAS EGELSTON
Maintenance Engineer, Marchant Calculators Inc

► SELLING TOPSIDE on the idea of a new wiring and lighting system for a building to be vacated within the next year and a half calls for some down-to-earth engineering.

Our plant in Oakland, California has been growing, along with many industries, over the past 20 years. The administration building getting the electrical revamp was originally a one-story affair. Somewhere along the line a second level was added. Now each floor has 4500 sq ft and a basement of 2500 sq ft. Original wiring in the form of knob and tube work ran into fused neutral-type panel boards.

As load grew new circuits were added to the 4-wire delta supply. This brought up the problem of maintaining phase balance for single-phase loads. Over the years incandescents bowed to fluorescents. Latter turned out about 20 foot-candles. All indicators pointed to a new electrical layout. Maintenance records showed trouble calls were on the upswing, fuses were being replaced with those carrying a higher rating, etc. And office workers started to complain about shortcomings of the lighting setup.

This condition is all too common around the country today. But here at Marchant something was done about it, even in the face of a move to new quarters. Engineers in the Plant Engineering Department worked up a report for the front office on why a major electrical revamp made good sense, right now. Here are the facts: To start with, some 90% of the branch circuits were overloaded. In the report, each overloaded circuit was identified and marked as to reason for overloading. Threat of fire was always present. On the positive side, a new electrical system promised lower maintenance costs while improving morale and efficiency.

Management, after getting the facts, looked on the proposed change as a simple matter of protecting their investment in men and equipment. Also, when and if the building is sold or leased (after the new quarters are available), the in-date system makes the deal more appealing.

Plant engineering designed the new system; maintenance crews installed it on the swing shift. Starting point was the service. Here a change was made from the original 100-amp 4-wire delta scheme to a 300-amp 4-wire wye plan. Three branch-circuit panels were changed from 20-pole 3-wire fused neutral to a 40-pole 4-wire circuit breaker center.

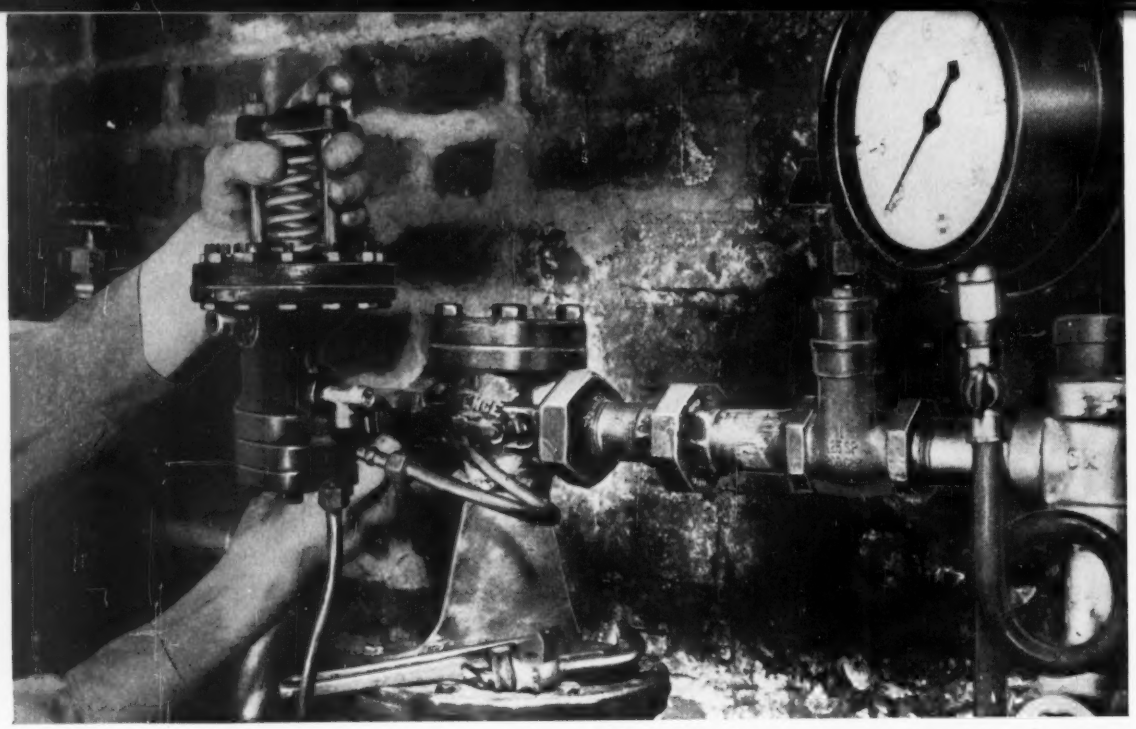
Tripling output of lighting scheme called for swinging from 4-ft to 8-ft fluorescents. The new slimlines have a 45-deg cutoff diffuser. Office-area fixtures (the old 4-ft units) were adapted for hallway lighting making a tidy savings in fixture cost.

Total cost was modest enough; somewhere around $10,000 for labor and material. New system now boasts 50 to 70 ft-c.

NEW LIGHTING LAYOUT offering a modest 50 to 70 ft-c is sharp contrast to old 4-ft fluorescents with a 20 ft-c output

NEW SERVICE GEAR follows standard design for small plant installations. Utility network voltage feeds in 208/120 volts

NEW SERVICE DROP run in alongside abandoned conduit is fed from a 3-phase 4-wire wye-connected transformer in street



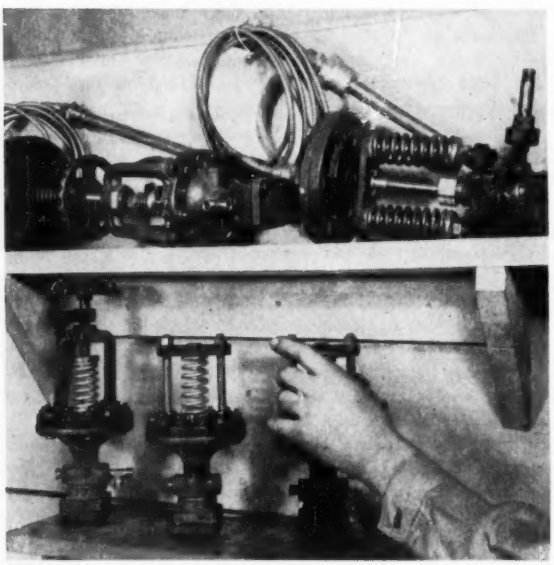
CONTINUOUS process interruption is practically zero when reducing-station pilot valve can be changed in a few minutes

Single or multistage pressure reduction?

It can make a difference in...

- **Safety**
- **Control**
- **Maintenance cost**

By C V PECK, *Chief Engineer, Spence Engineering Co, Inc*



SPARE PILOTS, reducing valves mean efficient maintenance

► ARE YOU USING single-stage pressure reduction? If so, it might pay to (1) recheck the system (2) weigh the factors involved in a possible emergency outage of the reducing station (3) check the actual efficiency (4) figure just how much the station's maintenance is costing you.

Unquestionably, single-stage reduction is satisfactory for many applications, even in some cases that require fairly high-pressure drops. Improved valve-seat and disk materials that won't wiredraw are available.

Multistage reduction, on the other hand, has advantages over single-stage and is preferred by many engineers. Chief reasons are: (1) it's generally safer (2) it's less noisy (3) it can cut maintenance costs (4) it can provide control accuracy to any desired degree.

Drop in noise level is probably the most apparent effect of multistage pressure reduction. One-stage reduction in a high-pressure line means considerable velocity at the regulator body outlet. High velocity means more turbulence and, in turn, more noise.

Example: Consider 100-psi saturated steam flowing into a regulator at

10,000 fpm. Regulator's job is to supply 5-psi steam for heating. To do that, it must expand the steam from its original volume (3.9 cu ft per lb) to 22.5 cu ft per lb. So velocity increases by the ratio 22.5/3.9, or from 10,000 fpm to 57,700 fpm. Such increase means marked turbulence and noise.

Outlet velocity rise is less, as are turbulence and noise level, with two-stage instead of one-stage reduction. For instance, assume first reduction in a two-stage station is from 100 to 40 psi. Incoming steam would expand from 3.9 to 8.1 cu ft per lb and velocity would rise to 20,800 fpm compared with 57,700 fpm in the one-stage reduction mentioned above.

This doesn't mean multistage reduction is the only solution to a noise problem. It may be most effective answer, but overall noise can sometimes be cut sufficiently by suppressing secondary noise sources in the distributing system apart from the regulator. For example, small pipes transmit less noise than large ones, and rigid piping is less noisy than a flexible network.

Copper-bellows expansion joints help you reduce pipe noise. Also, where possible, use a long straight run of pipe downstream from the regulator. This prevents the "drumming" sound of steam as it strikes elbows and tees.

Safety, always the most important factor, may dictate multistage reduction. Some city safety codes require two-stage reduction in street steam-piping systems. Where layout makes it impracticable to put a safety valve in the delivery piping, two-stage reduction comes into play. Then, steam from both or either stage is at or below safe working pressure. If one valve fails, delivery from the other is still below danger point. It's unlikely both valves will fail at the same time.

Dual-stage or multistage reduction also lessens chance of damage from boiler carryover, trap failure. In either condition, accumulated water builds up to a fast-moving slug that can wreck a single-stage, high-reduction station.

Continuous process system, even though protected by safety valves, can well use dual reduction. Safety valves can prevent damage, but they can't halt a temporary interruption of the process. A dual-stage station, with an extra pilot added to the primary, does the job. Pilot's diaphragm connects to final reduced pressure and is set to take over control if final pressure accidentally increases a few pounds. Thus, if first stage fails to close, second stage takes full drop with no interruption of flow. If second stage fails, first stage handles full reduction to within a pound or two of normal second-stage delivery pressure.

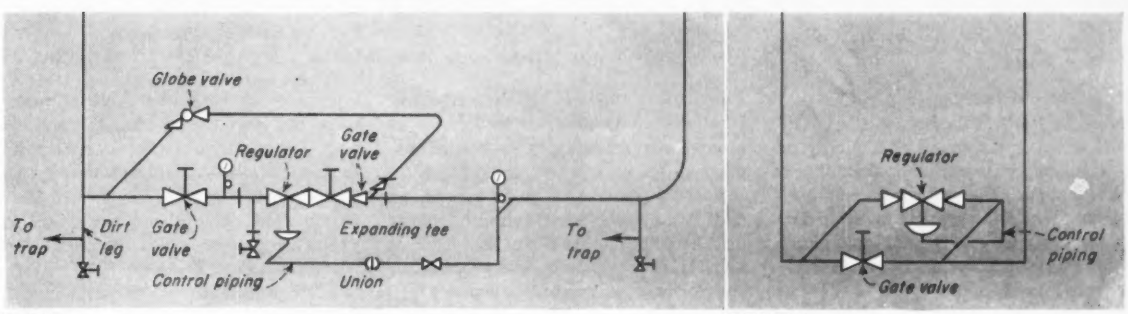
Multistage reduction can make a difference in operating costs in other ways. For instance, with a single-stage station a high-pressure drop across regulator causes thrust stress on valve disk. Stem transmits stress load to the operator. The greater the stress, shorter the regulator life is apt to be. Maintenance will cost more, too.

Turbulence. Another factor is turbulence. When a single-stage regulator senses the controlled pressure in the valve body, its accuracy may be disturbed by turbulence. Flow through the valve body and past the sensing point is fairly tranquil at low loads. Sensing-point pressure is about the same as in delivery piping. But as the load rises, so does turbulence in the valve body. "Choking up" occurs at the sensing point—makes the valve operate to cut down on the higher pressure it "believes" it's delivering. Net result is an unwanted drop in delivery pressure.

Tranquil flow, regardless of load change, is important where close control of final pressure is a must. The multistage station holds a big advantage here, in addition to the maintenance savings involved.

Maintenance can be simplified and process interruptions avoided with multistage systems if spare parts are at hand. Extra pilots result in quick replacement. Inspection or repair becomes a matter of convenience.

Conditions surrounding any specific application must, of course, be weighed by engineers in deciding if the advantages justify use of a multistage system.

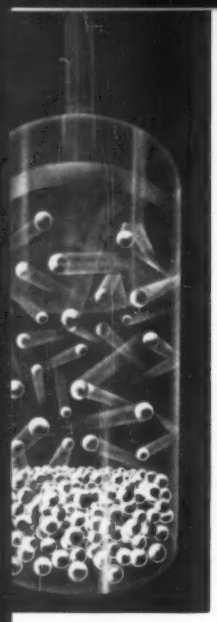


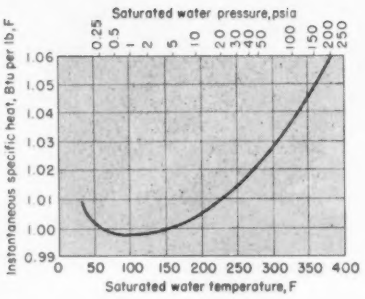
RIGHT **WRONG**

Why some reducing stations are noisy and others aren't

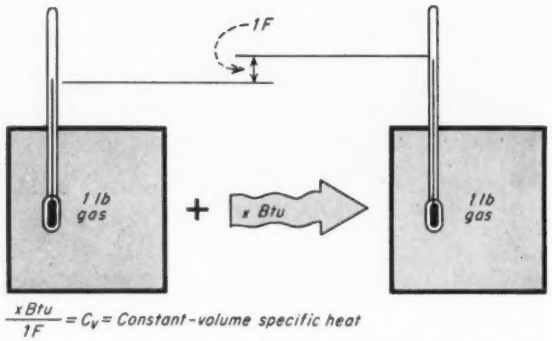
Right way to make installation as quiet as possible is shown above, left. Straight runs of piping are used before and after PRV. Long-radius elbows and traps cut possibility of water hammer. Expanding tee and line-size valves control velocity. Other features are valves to permit isolation of reducing elements; supply and delivery pressure gages; strainers and dirt legs fitted with blowoff valves.

Wrong way to install a pressure-reducing station is shown above, right. 90-deg elbows and short piping runs are conducive to noise from water hammer and steam "drumming." No isolating valves mean system must be shut down in order to service the station. Gate valve in by-pass is not suitable for throttling service. There are no gages; no strainers or dirt legs to keep foreign matter out of the valves.





1 Specific heat of saturated water varies with temperature and pressure



2 Specific heat of a gas at constant volume is the amount of heat that raises temperature of one pound by just 1 F

To figure energy changes from one form to another we have to know the relations between energy and the properties of a substance. As a first step towards this need we gather experimental data that shows how . . .

By B G A SKROTZKI
Associate Editor

Specific heats link together changes in both energy and temperature

► THERMODYNAMICS, as we should know by now, concerns itself largely with energy. We found that energy exists in many forms and that it can change from one form to another quite easily. While talking about the calorimeter, POWER, Nov 1956, p 95, we made a significant statement: Heat absorbed by water = heat developed by burning fuel. This is a practical application of the *First Law of Thermodynamics* which simply says energy cannot be created or destroyed; this is also called the *Law of the Conservation of Energy*.

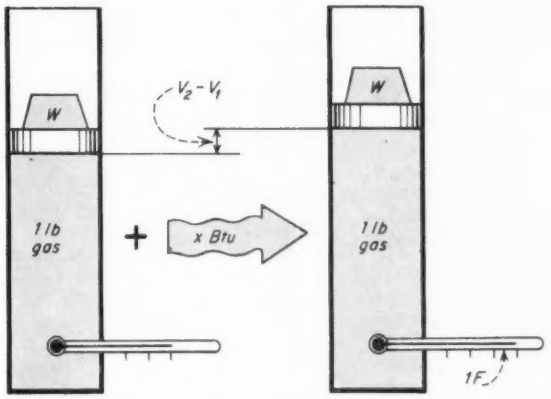
Since Einstein's premise on the interchangeability of matter and energy, it has been shown that this law is not absolutely correct. But since a minute amount of matter equals a large amount of energy we can safely ignore the changes in matter involved in the transfer of energy. As a working tool our First Law is good enough for our needs. It allows us to make energy balances around any machine or system of machines.

Specific heats. In many cases we find it impossible to measure energy directly as so many Btu or ft-lb or hphr; this is particularly true for thermal forms of energy. We actually calculate thermal energy from other indicators that we call properties, such as, pressure, temperature, volume and mass. To calculate thermal energy from this data we need constants called specific heats.

These constants have been determined by many experimenters. The most basic one is the specific heat of water—we define our thermal energy unit, Btu, in terms of what happens to water. Specific heat of a substance is the number of Btu's required to warm one lb of it by one degree F. For high accuracy work we must realize that the specific heat for most substances varies with the temperature. Table 1 shows how specific heats vary for water with temperature (at atmospheric pressure), as well as for some solids at given temperatures. Fig. 1 shows how specific heat of saturated water varies with temperature and pressure. Whenever calculating energy changes in a substance over a wide temperature variation, the proper average specific heat for the range must be used.

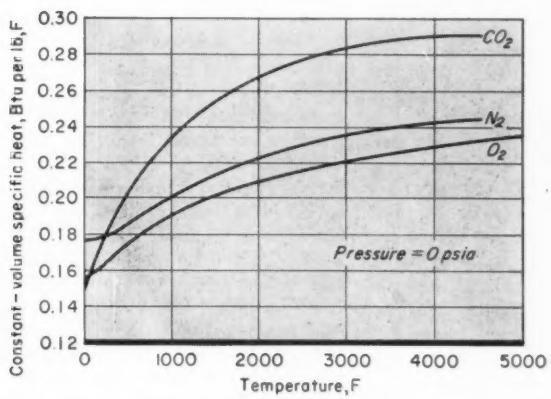
Example 1: During a forging operation a ½-lb iron piece at 1600 F is plunged into 10 lb of water at 50 F. Assuming an average specific heat for water of $c_w = 1.00$ and for iron of $c_i = 0.17$ find the final temperature of the water and iron.

We will assume no losses of energy



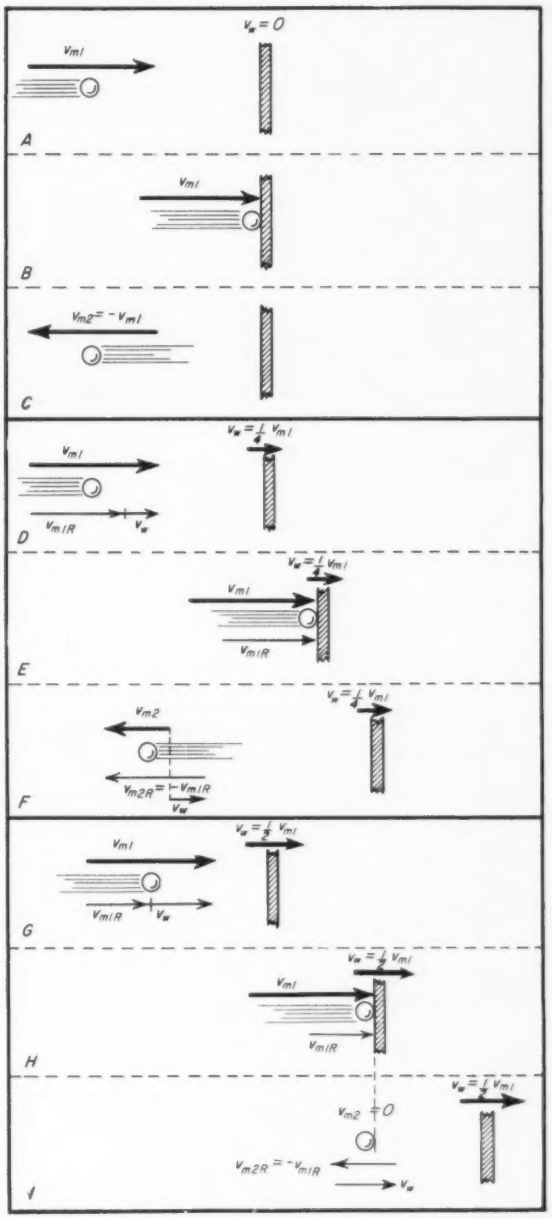
$\frac{x\,Btu}{1F} = C_p$ = Constant-pressure specific heat

3 Specific heat of gas at constant pressure is always larger than at constant volume because of work done on piston



4 Constant-volume specific heats for gases depend on temperature level and number of atoms in the gas molecule

5 *A* to *C*: Molecule does no work on fixed wall, retains its energy. *D* to *I*: Molecule works on moving wall, slows down



and apply the First Law by writing:

Heat given up by iron
= heat absorbed by water

Letting M_w = mass of water, lb, and
M_i = mass of iron, lb
t_w = initial water temperature, F
t_i = initial iron temperature, F
t_f = final temperature of iron and water, F

Then we may substitute in the first equation:

$M_i c_i (t_i - t_f) = M_w c_w (t_f - t_w)$

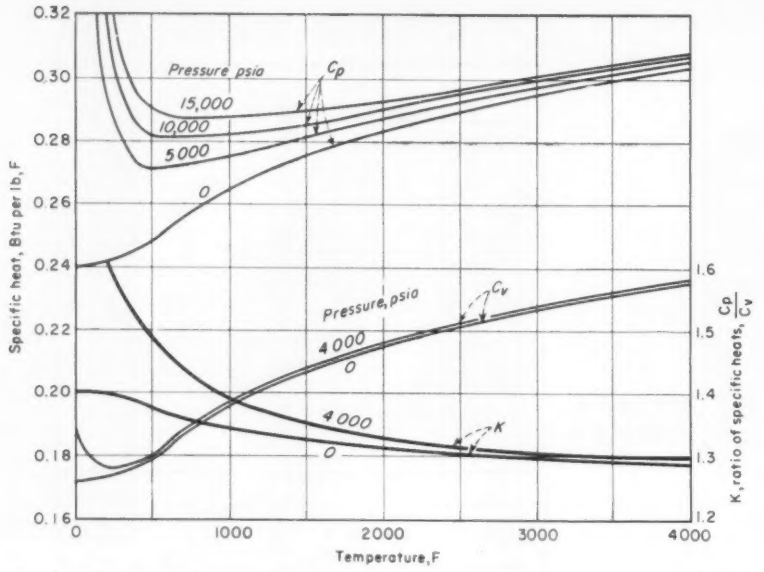
$0.5 \times 0.17 (1600 - t_f) = 10 \times 1.00 (t_f - 50)$

$t_f = 63.1$ F

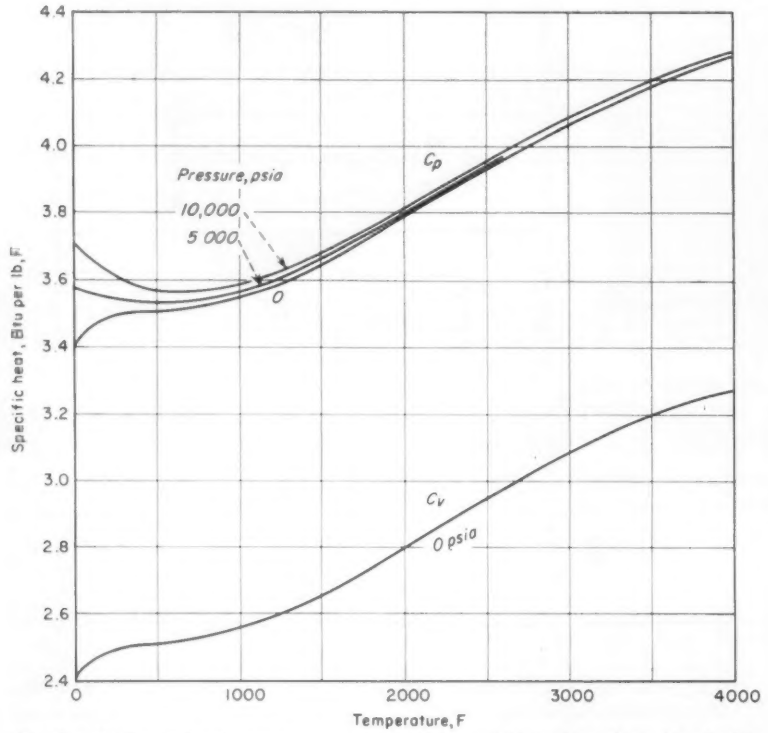
This example demonstrates the transfer of energy between substances and the high heat capacity of water. The ½ lb of iron cools from 1600 to 63.1 F while the 10 lb of water warms from 50 to 63.1 F. To understand more clearly what happens here, let's compare the temperature rises of one lb of iron and one lb of water when each absorbs one Btu of energy. The iron's temperature rises by $1/0.107 = 9.34$ F but the water's temperature rises by only $1/1.00 = 1$ F. (Here we're assuming iron at room temperature, so $c_i = 0.107$.)

As a matter of interest the specific heat of ice is 0.492 Btu per lb per F. Saturated steam at atmospheric pressure has a specific heat of 0.482 Btu per lb per F. Both of these water phases have less than half the specific heat of the liquid phase; water is one of the few substances having a high heat capacity.

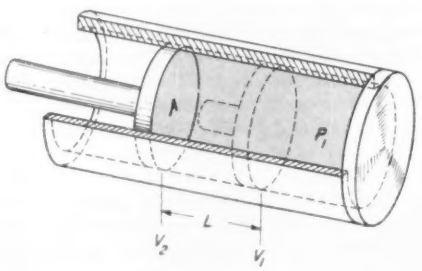
Gas specific heats. In dealing with specific heats of liquids and solids we only have the complication of variation with temperature. To make an accurate computation of energy change we must be sure to use the proper average specific heat for the temperature change involved. When dealing with gases we not only have a much more marked change in specific heat with tempera-



6 Specific heats of air at constant volume and constant pressure vary with both temperature and pressure. Ratio of specific heats also varies with properties



7 Specific heats for hydrogen run about 14 times higher than those for air, but ratio of specific heats, k, for both gases varies about same with temperature



8 Piston and cylinder are one of most important thermodynamic machines; heat added to gas, keeping pressure constant, makes gas do work on piston while it expands from V_1 to V_2

SPECIFIC HEATS continued

ture but we must also know what changes in volume or pressure are taking place.

When we confine a gas in a closed container, Fig. 2, and raise its internal energy by heating, the volume and mass stay constant. For this condition a gas has a *constant-volume specific heat*, c_v. The physical meaning of c_v parallels that for a liquid or solid. It's the unit energy absorbed as internal energy when increasing the temperature (motion of the molecules) of the substance. In a solid, the molecules bounce around faster in one general location; in a liquid, the molecules move faster past one another in close order; in a gas, the molecules fly through space in complete chaos, slamming into each other and the walls of the container billions of times a second.

The vital difference between the gas phase and the other two, solid and liquid, is the pressure or force that the gas exerts upon its container. *This pressure means that a gas can do mechanical work on any restraining wall if the wall moves.* To do such work the gas must use part of its internal energy. When the billions of molecules slam into a stationary plane wall they rebound with equal speed since their kinetic energy stays constant, Fig. 5 *A, B, C.* Kinetic energy of the molecule before and after hitting the wall is $KE = mv_{m1}^2/64.34$. Since the wall can't move, it doesn't absorb any of the kinetic energy from the speeding molecule. It does, however, resist the force exerted by the molecule while its direction is reversed.

When the wall does move (like the piston in a cylinder), we have the setup pictured in Fig. 5 *D, E, F.* Here we assume a simple case where the wall moves at a speed of v_w, just one-fourth of the molecule speed of v_{m1}. Both the wall speed and the molecule speed are measured relative to the earth. But the molecule speed relative to the wall speed is the difference of their absolute speeds $v_{m1} - v_w = v_{m1R}$.

When the molecule collides with the moving wall, it rebounds with a relative speed v_{m2R} that equals the relative approach speed v_{m1R} but is opposite in direction. During the collision, the molecule exerts a force on the wall. This force moves through a distance so the molecule does mechanical work on the moving wall. To do this work, the molecule gives up part of its kinetic energy.

We can calculate the molecule's energy loss (the work done) by finding the absolute speed of the molecule after collision. The molecule leaves the moving wall with a relative speed of v_{m2R}. But the wall itself is moving

away with an absolute speed of v_w, so we must subtract v_w from v_{m2R} to find the speed of the molecule relative to the earth, v_{m2}. This is done graphically in Fig. 5*F*. The work done by the molecule is then $m(v_{m1}^2 - v_{m2}^2)/64.34$.

Fig. 5*G*, *H*, *I* shows the conditions under which a molecule gives up all its kinetic energy to a moving wall. This happens when the wall moves at half the initial molecular speed. As the molecule hits the wall it comes to a dead stop, so that $v_{m2} = 0$. Note in Fig. 5*I* that the relative speed of the molecule leaving the wall is v_{m2R}, but the motion lies entirely in the receding wall; the molecule remains at the point of impact.

Thermal-mechanical conversion. If you get the meaning of the story told in Fig. 5 you will understand the basic process of changing heat energy to mechanical energy—one of the principal concerns of thermodynamics. Since internal energy is simply a form of molecular motion, we have to set up an arrangement where these energized molecules can impinge on moving walls and do work on a practical scale.

Specific heats play an important part in giving us information on how much energy we may expect to convert in given processes. As we said before, the specific heat of a gas depends on how it is handled during the heating. We've already discussed the constant-volume specific heat c_v. Instead of holding a gas in a closed container, we can put it in a cylinder plugged with a movable piston, Fig. 3. Now we have a choice of rates of volume expansion or contraction that we can allow the gas to undergo while heating or cooling it.

Of this infinite choice of heating processes, there are only two of practical significance (1) the constant-volume heating we already talked about and (2) the constant-pressure heating. In the latter, we allow the gas to expand so that its pressure stays exactly constant while it is heated, Fig. 3. But here we have the piston as a moving wall as in Fig. 5, so that the confined gas does mechanical work at the same time that its internal energy is being raised. Charles' law tells us that constant volume heating raises the pressure since $P = CT$ (POWER, Oct 1956, pp 98-99). Letting the gas expand against the piston makes it do mechanical work and give up some of its internal energy. So when we heat a gas in a constant-pressure process we must supply energy not only to raise its internal energy, but also to do work in expanding against a constant pressure. In that case c_p (constant pressure specific heat) must be larger than c_v.

Fig. 4 shows variation of c_v for carbon dioxide, nitrogen and oxygen with temperature. The specific heats show a marked increase with rising temperature. For this reason we must always know what the temperature range is when we make any energy calculations.

1 — Specific heats of some common substances, Btu per pound per F

Substance	*Btu per lb per F*
Ice at 32 F	0.492
Water at 32 F	1.0087
Water at 40 F	1.0048
Water at 63 F	1.0000
Water at 100 F	0.9975
Water at 160 F	1.0000
Water at 212 F	1.0065
Steam at 212 F	0.482
Lead at 70 F	0.031
Silver at 70 F	0.056
Copper at 70 F	0.092
Iron at 70 F	0.107
Aluminum at 70 F	0.214

Fig. 6 shows the variation of both c_v and c_p for dry air with temperature at different pressure levels. At temperatures above 200 F, pressure has only a negligible effect on c_v. At room temperatures, the effect is more noticeable; but even at 0 F raising the pressure to 4000 psia increases c_v by less than 10%. Pressure, however, has a marked effect on c_p, especially at the lower range of temperatures.

Later on, we'll find that the *ratio of specific heats:* $k = c_p/c_v$ will be an important factor in our figuring. Fig. 6 shows how k varies with temperature and pressure. Since c_p is sensitive to pressure, we find that k is too. Increasing temperature reduces k, but increasing pressure raises k, especially at the lower temperatures.

Fig. 7 shows specific heat variations for the light gas, hydrogen. These run more than 14 times the specific heats for the heavier gases in Fig. 4 and 6.

Mechanical work. The constant pressure heating process of a gas gives us a clue on how to get mechanical work out of thermal energy. Next, we must find a way of figuring the relation between the two.

In Fig. 8, suppose we have one lb of gas trapped behind the piston in the cylinder with a volume of V_1 and a pressure of P_1. Now if we add energy to the gas by heating and let the gas expand so that P_1 stays constant, the volume grows to V_2. How much mechanical work has the gas done on the piston in moving it through the length L?

Mechanical work is measured by the product of a force working through a distance. Let's first find the force. The total force acting on the piston is simply the product of the pressure P in psf and the area of the piston A in sq ft so that:

$$F = P \times A$$

The piston is moved through the distance L by this force so that the work done:

$$W = L \times F$$

substituting

$$W = L \times P \times A$$

But studying Fig. 8, we find that $L \times A$ is the volume swept out by the expanding gas, and

$$L \times A = V_2 - V_1$$

substituting

$$W = P(V_2 - V_1)$$

This last equation shows that we need only know the changes in the measurable properties of the gas to calculate the work done by one lb of gas.

Relation of c_p and c_v. This last equation for a constant pressure process can be used to find the relation between c_p and c_v. Remember that for one lb of gas $PV = RT$, we can substitute in the last equation and get:

$$W = R\,(T_2 - T_1) \text{ ft-lb}$$

$$= \frac{R}{J}(T_2 - T_1) \text{ Btu}$$

This evaluates the mechanical work done in a constant-pressure heating process. But this process has two parts so we can write:

Heat input = work done
+ gas internal energy rise

We can figure the internal energy rise from the constant-volume heating process. So knowing the gas and the c_v for this gas, the internal energy rise:

$$E_2 - E_1 = c_v(T_2 - T_1)$$

On the other hand, the total heat input during a constant-pressure process:

$$Q = c_p(T_2 - T_1)$$

Bringing these factors together in the basic equation:

$$Q = P(V_2 - V_1) + (E_2 - E_1)$$

substituting

$$c_p(T_2 - T_1) = \frac{R}{J}(T_2 - T_1) + c_v(T_2 - T_1)$$

Dividing through by $(T_2 - T_1)$ we get

$$c_p = (R/J) + c_v$$

rearranging

$$c_p - c_v = R/J$$

Remembering that $k = c_p/c_v$ and substituting, we get relations:

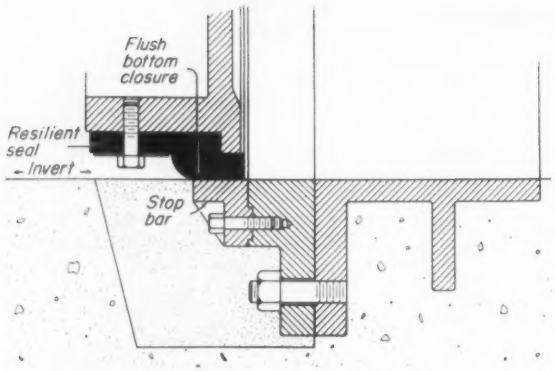
$$kc_v - c_v = R/J$$

$$c_v = (R/J)/(k-1)$$

$$c_p = (R/J)k/(k-1)$$

The important relation to note here is the difference of the two specific heats equaling the gas constant over J which remains constant for most processes. Always make sure that c_p, c_v and k apply to the pressure and temperature ranges you deal with in future calculations.

Next part will deal with more energy relations and gas processes.



New bottom seal arrangement for . . .

Watertight sluice gate

By T B RICHARDS, *Superintendent, Sunbury Plant, Pennsylvania Power & Light Company*

► CONVENTIONAL SLUICE GATES have bottom wedges protruding below the invert. This requires installing a sill, sometimes as high as 18 in. above floor level. These sills are permanent hazards to personnel and prevent easy moving of heavy apparatus or rolling stock during ordinary repair and maintenance operations.

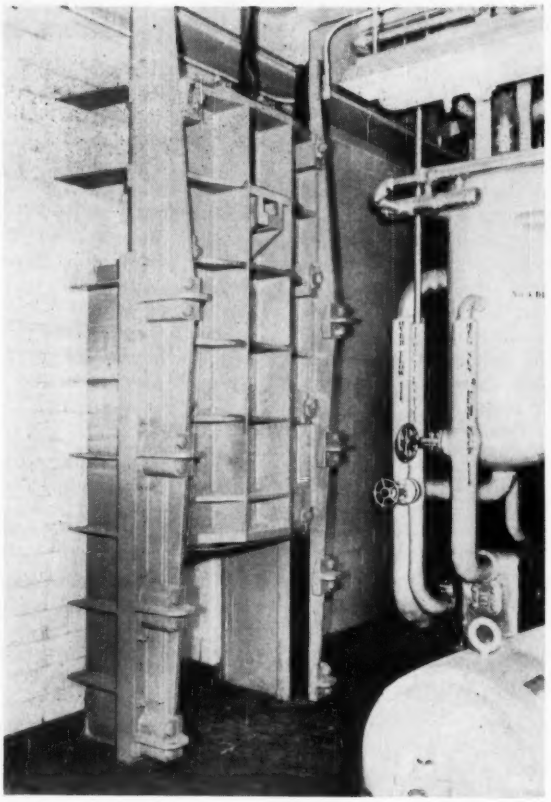
Two of the units at Sunbury Station have areas that are normally several feet below low river level. During river floods water must be kept out of these areas, especially if the pumps should fail. Sluice gates offered by Rodney Hunt Machine Co, Orange, Mass., have features that particularly suit the solution of this problem.

These gates have a bottom closure completely flush with the floor, see cross sections above. This gives a tight seal and has no sill to trip over. These gates were originally designed to allow using 100% of a sluice head. The faster flow gives better flushing action so that silt and trash will not prevent closing the gate.

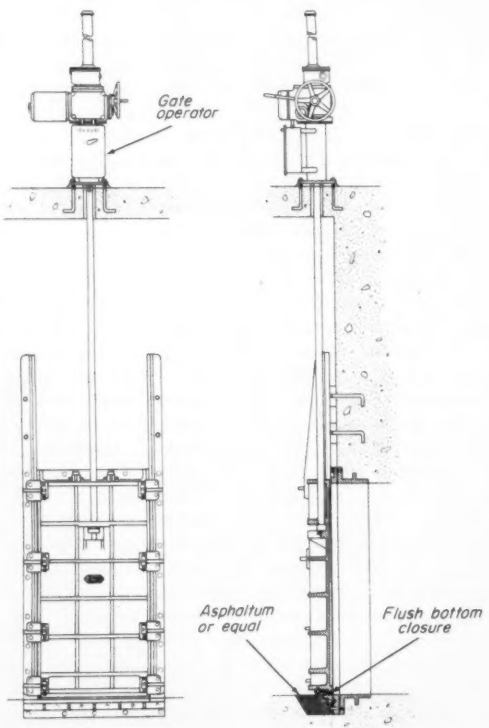
In this new design the gate frame is lowered so the opening stands flush with adjacent chamber floors. There are no deep pockets in which wedges must descend. On conventional gates, wedges on top, bottom and sides force the disk tightly against the frame. The wedge at the bottom must extend below the clear openings; the gate must slide down past a vertical wall barrier standing square across the channel and projecting above the invert; or the bottom of the gate and bottom wedge must drop below the invert in a pocket formed in the channel floor.

The Rodney Hunt gate has cast iron bronze-mounted construction. In the closed position heavy bronze wedges on top and sides hold it tight against the frame. The bottom of the gate disk carries a heavy strip of neoprene which flexes and gives a "cushion closing" seal when compressed on the stop bar.

Flush positioning of the gate bottom with the invert allows the outflowing chamber to drain completely. This design also allows extra headroom and space for gate and stem travel in indoor and underground locations. Similar gates are used in hydroelectric plants, industrial and municipal water filtration stations and sewage control projects.

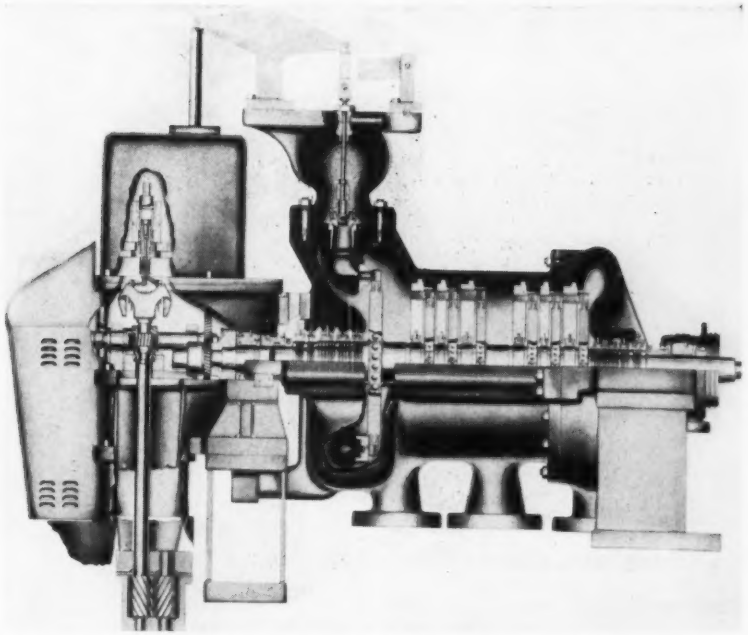


SLUICE GATE, 42 × 84 in., normally open gives emergency protection against flooding in Sunbury Station boiler room



FLUSH BOTTOM CLOSURE sluice gate installed with flat frame and wall thimble seats on the invert even with the floor

Today's high-pressure, high-output central stations demand increasing power and speed for boiler-feed pumps. Here's one solution:



TURBINE delivers 6230 hp at 5610 rpm; features two steam inlets, solid rotor

6230-hp turbine drives boiler-feed pump

► On November 28, the General Electric Co's Small Steam Turbine Dept, Fitchburg, Mass., shipped its No. 1 steam turbine for boiler-feed-pump drive in a central station. This 6230-hp, 5610-rpm machine will drive the full-sized boiler-feed pump for American Gas & Electric Co's Glen Lyn station.

Why it's feasible. GE officials feel that turbine-driven pumps rather than conventional motor-driven units will prove practicable in many stations generating over 150,000 kw, with steam pressures over 1800 psig. Economics will decide the issue.

Normally, it takes 2.5 to 3.5% of station output to run a motor-driven boiler-feed pump. Under favorable conditions, use of a turbine drive permits releasing this energy to salable kilowatts, they say. There may also be station heat rate gains (about .1 to .7%).

These advantages must be balanced against the need for larger boiler capacity, additional piping, control valves, modifications to the main steam turbine and condenser, etc.

Aside from the economic evaluation, boiler-feed-pump turbines compared to motors are said to offer these advantages: (1) high-speed drive for pumps whose optimum speed is in the range of 5000 to 7000 rpm (2) variable-speed drive (3) less space required (4) low electrical power requirements for starting the station or keeping it going with the main turbine down (5) minimized risk of flashing pump suction from the deaerator. Noncondensing extracting feed-pump turbine allows simplification of piping and foundation under the main turbine.

How turbines work. Unit, above, is typical of noncondensing type. There are two steam inlets. Upper-half admission is at 500 psi, 700 F; steam enters from the cold reheat connection. Lower-half admission, at 2000 psi, 1050 F, is directly from the boiler outlet. This steam is used only for starting and low-load operation. Steam is extracted and exhausted to station feedwater heaters.

Boiler is filled initially by a low-pressure motor-driven pump. When steam pressure in the boiler reaches 100-300 psig, the turbine-driven pump is cut in. It operates on steam directly from the boiler outlet until there is flow in the cold reheat line. Starting can be as automatic as desired.

Unit has separate nozzle plates for high- and low-pressure steam. Altogether there are five steam connections (two inlet, two extraction, one exhaust). This can vary according to station needs. Flex plates and radial keys prevent distortion, unusual stress.

A turning gear prevents shaft from bowing during shutdown. Stop valves have stem sealing. High-pressure steam chest can be kept warm for fast starting by control-valve gland leakage and proper arrangement of station piping. Turbine can be started in 25 to 30 sec.

Casing is made of carbon steel. Guarded oil piping is used and the flexible coupling to the pump is arranged for continuous lubrication from the turbine oil system.

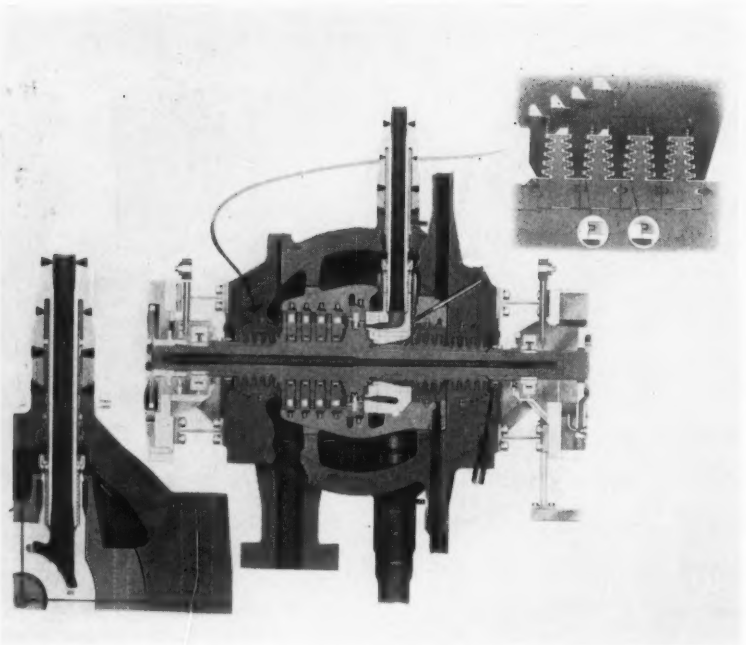
A signal from the boiler control regulates feed-pump output by modulating the turbine valve position, either directly or through the speed governor.

Condensing units. For condensing units, throttle steam will be extracted from the reheat turbine, probably from the crossover to the low-pressure turbine. Reducing the exhaust flow, and therefore the exhaust loss, of the main turbine for a given generator output will increase cycle efficiency. The greatest gains will be made when main turbine's exhaust loss is high.

Supercritical installations, with once-through boilers will need a large motor-driven pump to establish about 30% max flow, and pressure above critical, before fires are lighted. This pump may eliminate need for auxiliary nozzles on the feed-pump turbine.

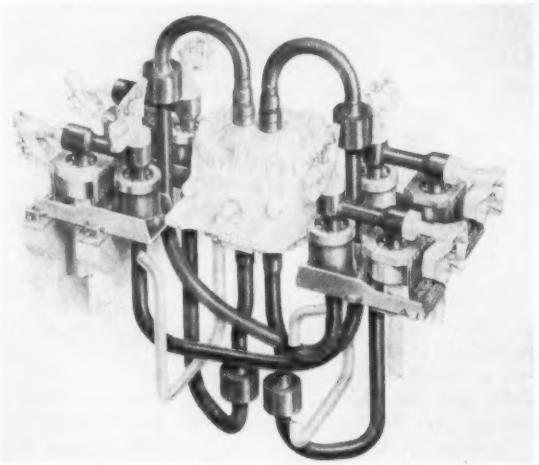
GE engineers say these turbines will be advantageous in supercritical plants because ratio of feed-pump power to generated power increases with boiler pressure, and their use will increase incremental net kw available.

In the constant battle to keep production costs down, station designers seek ways to use less fuel. Here's how the Philadelphia Electric Company will do it in its . . .



1 Superpressure element takes steam at 5015 psia and 1200 F, expands it to 2500 psia and 1000 F to produce 44,000 kw. Nested-type radial seals shorten shaft

EDDYSTONE PLANT— new high in using superpressures



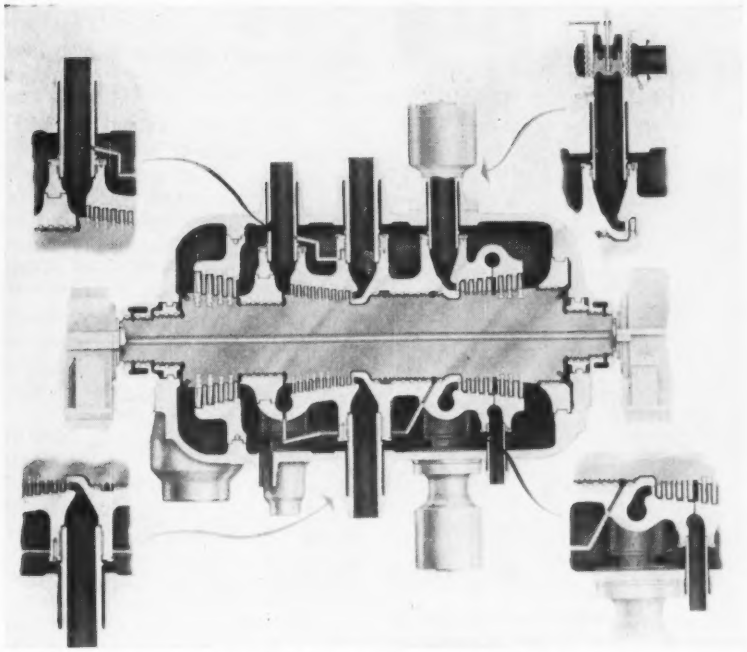
2 Governor valves and inlet piping to superpressure element work at full admission over complete load range of unit

► To ACHIEVE a net heat rate of 8016 Btu per kwhr, 42.6% thermal efficiency, Philadelphia Electric Co has projected a 325,000-kw unit for 1960 operation. It will run at 5000-psia 1200-F throttle conditions with two stages of reheat to 1050 F. The unit will be erected in a new plant at Eddystone, Pa. In addition to applying superpressure steam in a giant-sized unit many other factors have been carefully weighed to gain top performance.

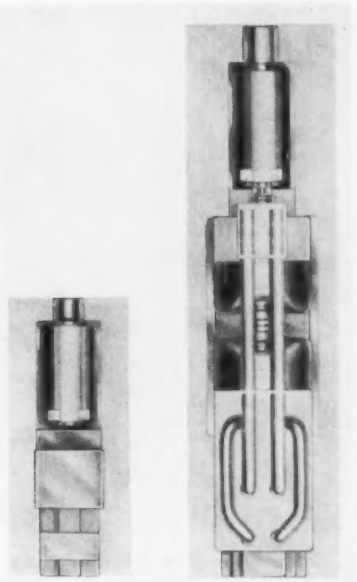
Turbine. During shakedown runs the turbine will use 1150 F, but for normal operation the temperature will be raised to 1200 F. The turbine has nine extraction points but only eight are used, Fig. 12. Instead of the second extraction point the cycle will use a stack-gas cooler for this feedheating stage. Feedwater temperature out of the last stage will be 551 F at full load and 563 F out of the h-p boiler-feed pump.

At rating, the turbine takes 2,000,000 lb steam per hr. The unit has eight rotating elements on two shafts, Fig. 5. The h-p shaft runs at 3600 rpm, is driven by turbine elements called: superpressure, *SP;* very-high pressure, *VHP;* two stages of high pressure, HP_1 and HP_2. The last three elements are in one casing. The l-p shaft runs at 1800 rpm driven by a double-flow intermediate-pressure element and two l-p turbines in parallel exhausting to a common condenser, Fig. 8. At rating the h-p shaft produces 45% of total unit output.

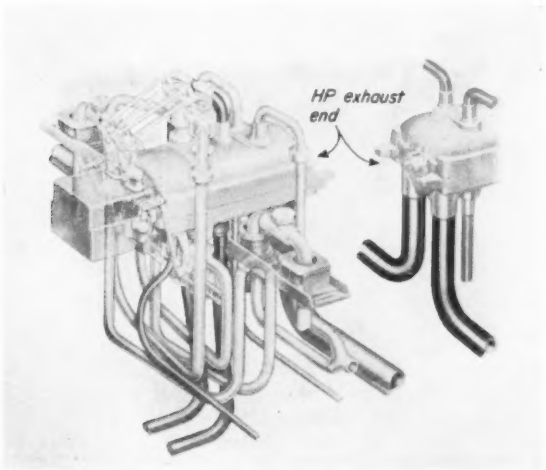
SP turbine. Fig. 1 and 2 show the



3 Very-high pressure element, in center, takes exhaust from superpressure element, sends steam to first reheat. Hot steam enters element, right, exhausts at left



5 325-mw cross-compound unit has 3600-rpm h-p and 1800-rpm l-p rotor



4 VHP-HP turbine element has two inlet pipes, six cold reheat pipes, four hot reheat pipes, extractions at two points

This story on the Eddystone plant has been abstracted from the following ASME papers (annual meeting):

No. 56-A-165. *Engineering the Eddystone plant*, by J H Harlow, Philadelphia Electric Company

No. 56-A-164. *Engineering the Eddystone steam generator*, by E M Powell, Combustion Engineering, Inc

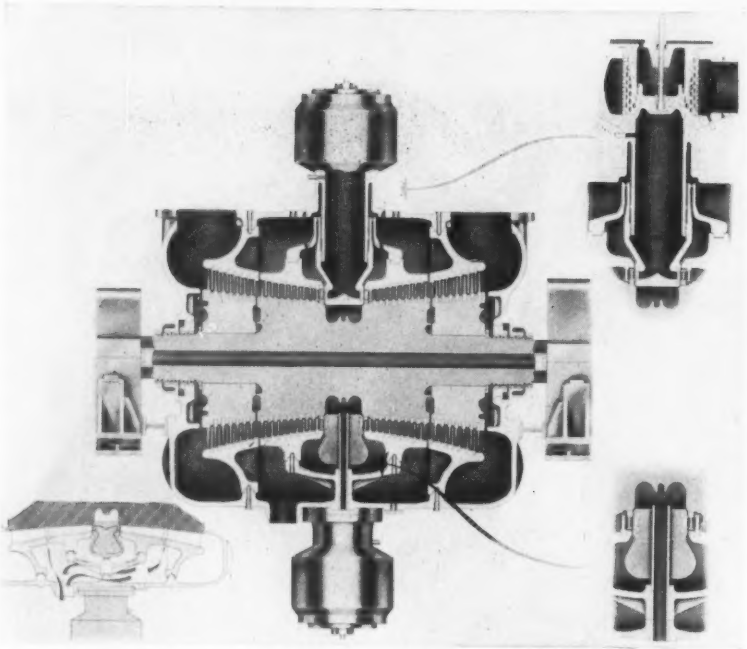
No. 56-A-156. *The Eddystone superpressure unit*, by C B Campbell, C C Franck, Sr, J C Spahr, Westinghouse Electric Corporation

For copies of these papers write: American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y. (50c per copy)

SP element which takes in steam at 5015 psia, 1200 F and exhausts it at 2500 psia and 1000 F. Steam enters through four inlet lines, each with a stop and governing valve. Each of the inlets connects to one of four nozzle chambers, gives full circumferential admission to the first of five impulse stages. Only the first stage is velocity compounded.

The first stage operates with complete admission at all loads. This avoids blade shock loading and rotor deflection that would be caused by running with partial admission.

The SP turbine has a ferritic steel outer casing and an austenitic steel, Type 316, inner casing. The 2500-psia exhaust fills the space between casings. Fig. 1 and 2 show the steam inlets in inner and outer casings. These austenitic alloy pipes connect to the outer casing through transition pieces and welds. Inlet pipe prolongations extend into nozzle chambers through slip joints, sealed by stacked-type sealing rings. These rings, alternately fitted with very small clearance to the turn of the inlet pipe and the bore of the nozzle chamber, allow relative motion of the parts in all direction. Baffles between inner pipe and outer-casing snout shield the outer casing and transition piece from the 1200-F inlet piping radiation. Baffles consist mostly of spirally surfaced cylinders surrounding the pipes, supplemented by orificed steam leakoffs from the casing end of the transition pieces and terminating in



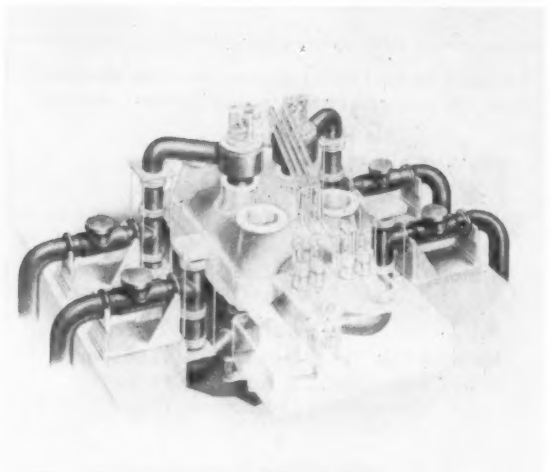
6 Intermediate pressure element runs at 1800 rpm with double-flow arrangement. This element takes steam from second reheater at 1050 F and 251 psia pressure

EDDYSTONE PLANT continued

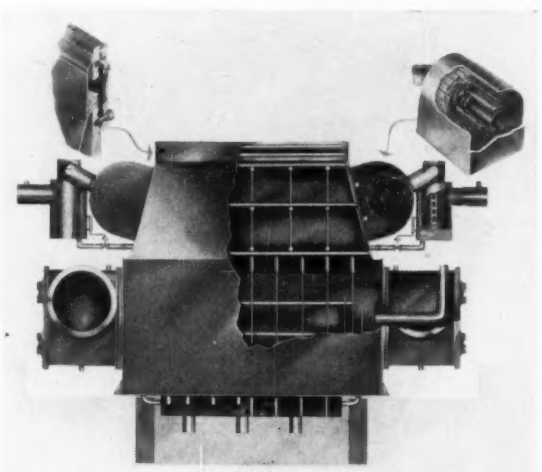
the VHP unit, Fig. 1, *left*, p 102. SP turbine exhaust steam at 1000 F flows outward, then inward along cylindrical baffle to the VHP unit. This gives adequate cooling while causing an insignificant overall loss. To prevent excessive heating of stagnant steam and outer casing, an outlet at the right end of the inner-casing space connects to the main exhaust lines and insures bathing the interior of the outer casing with exhaust steam.

Fig. 1, *right*, p 102, shows nested-type radial seal used in SP turbine to keep the shaft down to a reasonable length and still get the needed number of throttlings for the leakoff.

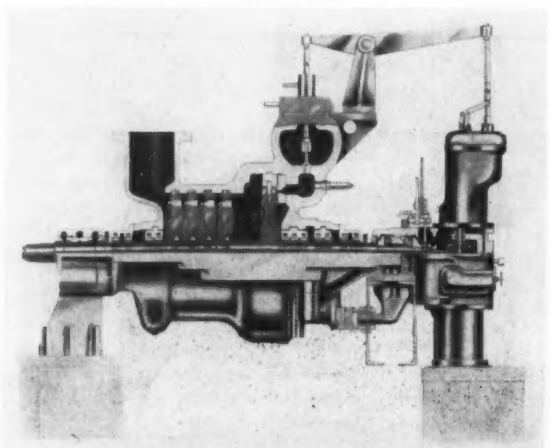
The SP rotor weighs about 3500 lb and will produce 44,000 kw. While relatively small for single piece construction it requires an ingot and rough forging well beyond prior experience in working with high-temperature alloys. Two rotors will be made of dif-



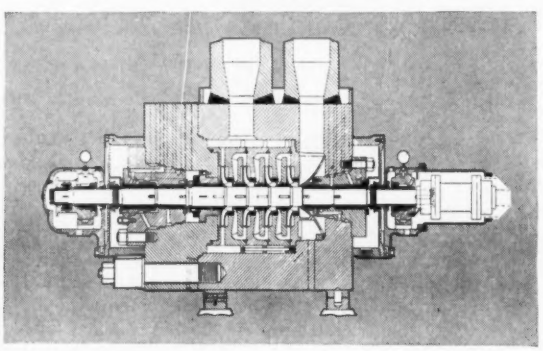
7 Inlet steam enters IP element through four reheat stop valves ahead of four interceptor valves on turbine base



8 Divided water-box condenser has 150,000 sq ft surface. Four injection coolers, top right, handle bypassed steam



9 H-p feed-pump-drive turbine uses 1110-psia 790-F steam to produce 3530 hp. Inlet, exhaust steam pressure varies



10 Six-stage h-p boiler-feed pump takes suction from i-p feed pump. Water may be pumped through under 1/3 load

ferent high-temperature alloys with expected long life. To insure having an operable rotor on hand two forgings of more conventional turbine alloys have been ordered. These would give backup rotors with reasonable but limited operating life.

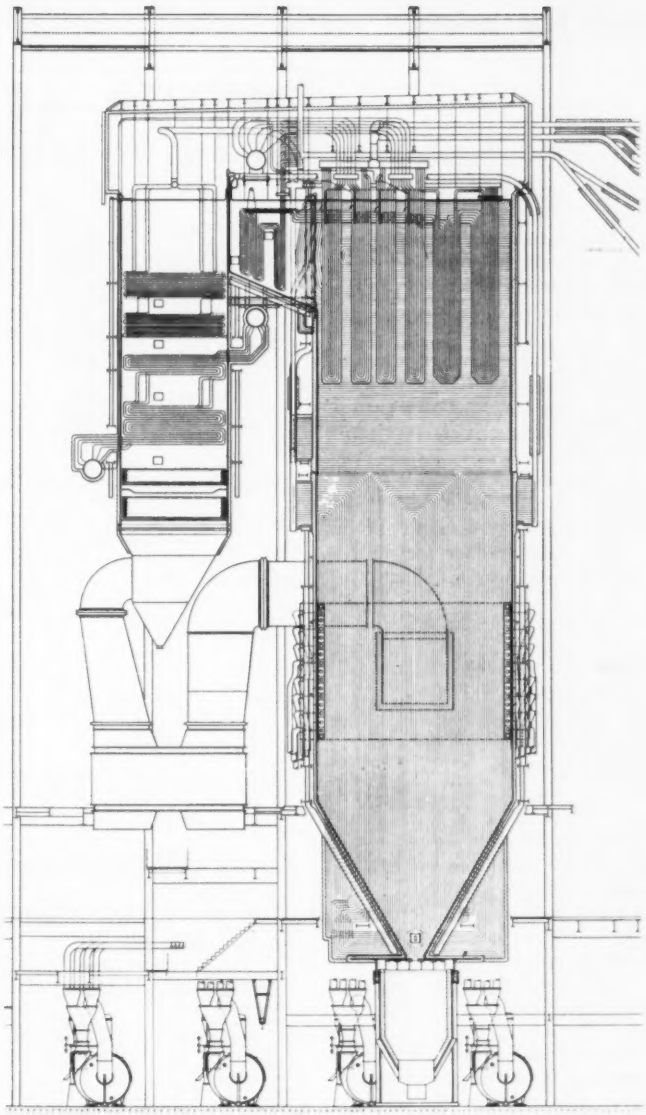
VHP-HP turbine, Fig. 3 and 4, takes steam directly from the SP element at the center of its casing. From the VHP element the steam goes to the first reheater at 1133 psia and 790 F. The first extraction taps the cold reheat line. Reheated steam at 1050 F and 8% lower pressure enters the first section of the HP element where steam for the second extraction taps off. The first section of the HP element exhausts into the space between inner and outer casings to enter the second section at the opposite end of the casing. This section exhausts to the second reheater at 283 psia.

This arrangement balances the thrust between elements and cools the outer casing. Fig. 4 shows the crowded piping associated with this casing.

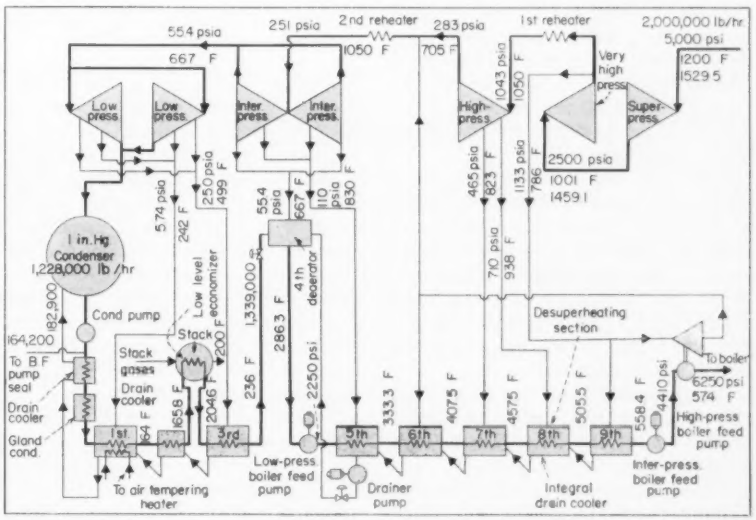
IP turbine, Fig. 6 and 7, takes reheated steam from the second stage at 1050 F, at the center of its casing. Double-flow arrangement reduces the diameter needed for the chrome moly vanadium rotor. As Fig. 5 indicates, each section of the IP turbine feeds one section of the LP turbine. The latter had to be built in two sections to reduce leaving losses from the last stage to a minimum, giving good overall performance.

Main condenser, Fig. 8, has 150,000 sq ft surface designed to handle 1,288,000 lb steam per hr. It will maintain a backpressure of 1 in. Hg abs with 200,000 gpm of 58-F circulating water flowing through the tubes. The condenser surface is divided into two tube bundles in a common casing. Entire waterside of the tube sheet is sprayed with a neoprene coating and extends inside the tubes for about 5 in. The lining prevents tube-end erosion.

The hotwell is divided horizontally into two sections. The upper section receives condensate dripping from the tubes. It is divided into 20 sections vertically, 10 under each tube bundle. Condensate flows from each of the 20 compartments into the lower hotwell through pipes holding salinity indicators. Lower section of the hotwell is



11 Superpressure steam generator to produce 2,000,000 lb steam per hr has two identical furnaces. Each furnace serves one of two reheaters for easy control



12 Station heat balance uses two separate lines of feedwater heaters and boiler-feed pumps in parallel, few valves

divided into three compartments connected by an equalizing pipe with shut-off valves. Each section connects to the suction of one of three condensate pumps.

When tube leakage contaminates any section, the condensate can be diverted to a bitter water tank. This water will be treated in demineralizers before returning to the cycle.

Trays attached to each tube sheet just below the tube bundle collect condensate that runs down face of the tube sheet. Four pipes draining these trays have salinity indicators to detect tube joint leakage.

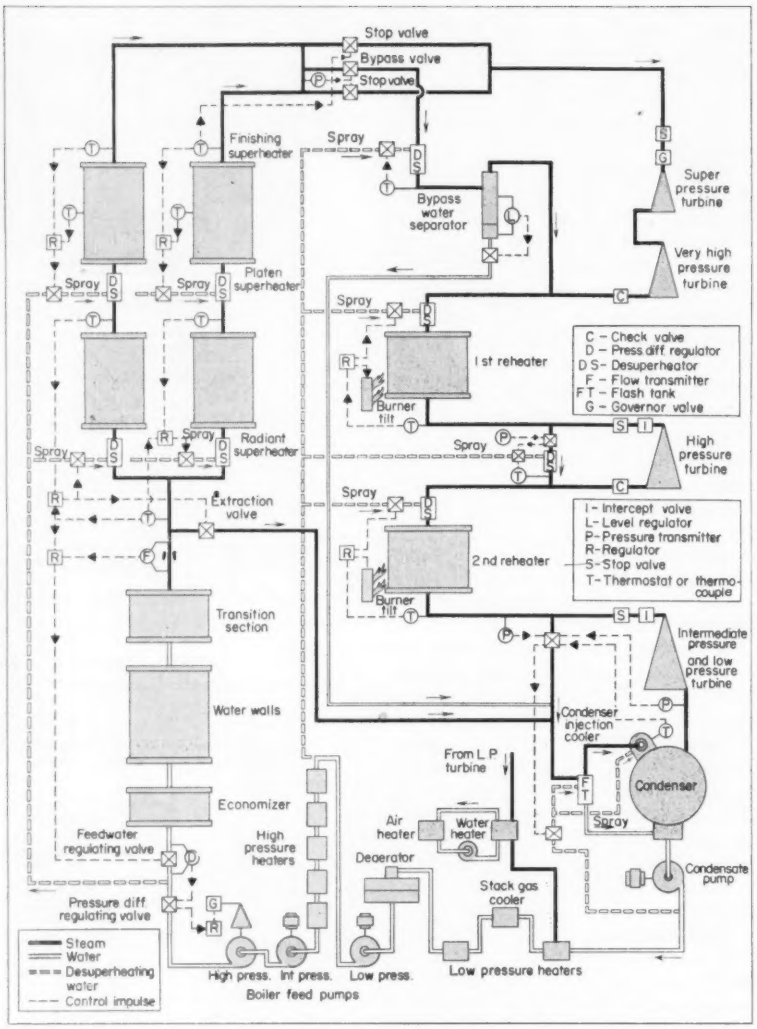
During startup or tripout, steam must be diverted directly to the condenser. To protect this unit from high pressure and temperature the steam passes through four injection coolers. These act as desuperheaters and pressure reducers. A maximum of 700,000 lb steam per hr can be handled by these coolers at 55 psia and 1050 F. After desuperheating, the steam flows through dump chambers that drops pressure in nine stages through perforated pipes to full condenser vacuum. Before entering the condenser a spray of condensate drops the steam temperature below 175 F to protect the turbine.

Steam generator, Fig. 11, has two identical dry-bottom furnaces, each fired with tangential burners in the four corners. Each furnace has one of the two reheaters that can be individually controlled by burner tilt.

Superheaters and reheaters absorb 65% of the total heat. Need for more than usual radiant heating surface leads to choosing radiant superheaters on upper furnace walls and widely spaced platens suspended in the upper furnace. These cool the gases to about 1650 F before they enter finishing stage of the superheater.

Feedwater enters economizer, flows up through tubes cooling the sidewalls of the convection pass. A header collects the water on each sidewall and directs it through piping to the entrance to the tube circuits covering the lower furnace walls. These up-and-down circuits terminate in two headers at the center of the front wall.

Water collected at this point goes through piping to the convection surface at the top of the rear pass through tubing forming cooling area for front and rear walls of the convection pass. Water-to-steam transition takes place in this zone of low gas temperature and reduced heat transfer.



13 Simplified, overall plant flow diagram shows elaborate bypass arrangement needed to bring plant up from cold and to handle sudden large changes in load

Two separate circuits run to this point for each furnace—a total of four. Each circuit has its own independent control system to maintain uniform metal temperatures and match water flow to heat absorption. Each circuit then subdivides into two and goes to the radiant superheater forming the walls of the upper third of the furnace. Here it passes through a series of horizontal tube circuits up to the roof. Final superheating takes place in the platens in the upper front corner of the furnace and the convection pendant loops just beyond the furnace outlet.

Control system, Fig. 13, has three duties: (1) Regulates steam temperature by controlling feedwater flow and distribution. (2) Regulates the bypass system to protect the turbine and steam generator during starting and emergency conditions. (3) Combustion controls, interconnected with the turbine, regulate fuel and air flow to output demands and holds the proper steam pressure.

The control system regulates steam temperature at three points in the circuit: (1) outlet of transition section (2) outlet of radiant superheater (3) outlet of finishing superheater. This gives positive control at throttle and more complete control of metal temperatures in the steam generator.

Internal length, inches	Internal diameter, inches																			
	10	12	14	16	18	20	22	24	26	28	30	32	34	36	42	48	54	60	66	72
18	6	9	12	16	20	24	30	35	41	48	55	63	71	79	108	140	178	220	267	317
24	8	12	16	21	26	33	39	47	55	64	73	83	94	106	143	188	237	293	356	423
30	10	15	20	26	33	41	49	59	69	80	92	104	118	132	180	234	297	367	444	529
36	12	18	24	31	40	49	59	70	83	96	110	125	141	159	216	282	357	440	532	634
42	14	21	28	36	46	57	69	82	97	111	128	146	165	185	252	328	416	513	621	740
48	16	23	32	42	53	65	79	94	110	128	146	167	189	211	288	376	475	586	710	846
54	18	26	36	47	59	73	89	106	124	143	165	188	212	237	323	422	534	660	799	951
60	20	29	40	52	66	82	99	117	137	160	184	209	235	264	360	470	594	733	888	1057
66	22	32	44	57	73	90	108	129	152	176	202	229	259	291	395	516	653	807	977	1163
72	24	35	48	63	79	98	118	140	166	192	220	250	283	317	431	564	713	880	1066	1259
78	26	38	52	68	86	106	128	153	179	208	238	272	306	343	468	610	771	953	1154	1375
84	28	41	56	73	92	114	138	164	193	223	257	292	329	370	503	658	832	1027	1243	1480
90	31	44	60	79	99	122	147	176	207	239	275	313	354	396	539	704	890	1100	1332	1586
96	33	47	64	83	106	130	158	187	220	256	293	334	377	422	575	751	950	1173	1420	1692
102	35	50	68	89	112	138	168	199	234	272	312	355	400	449	612	799	1011	1258	1510	1797
108	37	53	72	94	119	147	178	211	248	288	330	376	424	476	648	846	1071	1322	1600	1903
114	39	56	76	99	125	155	187	223	262	303	349	397	448	502	684	893	1130	1395	1689	2010
120	41	59	80	104	132	163	197	235	276	319	367	417	471	528	720	941	1190	1469	1778	2116
132	45	65	88	115	146	180	217	259	303	353	403	459	518	581	791	1034	1308	1615	1956	2327
144	49	71	96	125	159	196	236	282	330	384	441	502	566	634	864	1128	1428	1762	2133	2538
156	53	77	104	135	172	212	257	305	359	415	477	543	612	688	935	1221	1546	1910	2310	2748
168	58	82	112	147	185	228	276	328	386	448	513	584	660	740	1060	1316	1666	2056	2489	2960
180	61	88	120	157	198	245	296	353	413	479	551	626	706	792	1080	1410	1785	2202	2667	3172
192	65	94	128	167	211	261	315	376	440	512	587	668	754	846	1151	1504	1904	2350	2845	3383
204	70	100	135	178	224	277	335	399	469	544	623	709	802	899	1224	1598	2022	2497	3020	3595
216	74	106	144	188	238	294	355	423	497	576	661	752	848	951	1296	1692	2142	2643	3200	3808
228	78	111	152	198	251	310	375	445	524	608	698	794	896	1004	1368	1786	2260	2790	3377	4020
240	82	117	160	209	264	326	394	470	552	640	734	835	943	1058	1439	1880	2380	2937	3555	4230

Capacities of cylindrical tanks —U. S. gallons

► THIS TABLE helps you attack a tank problem three different ways: (1) Knowing the internal dimensions you can quickly find the gallonage. (2) If you know the capacity needed and the maximum diameter that can be accommodated you can quickly find the length needed. (3) Knowing the capacity needed and the maximum length that can be accommodated you can find the diameter needed. This table is based on 1 U.S. gallon = 231 cu in.

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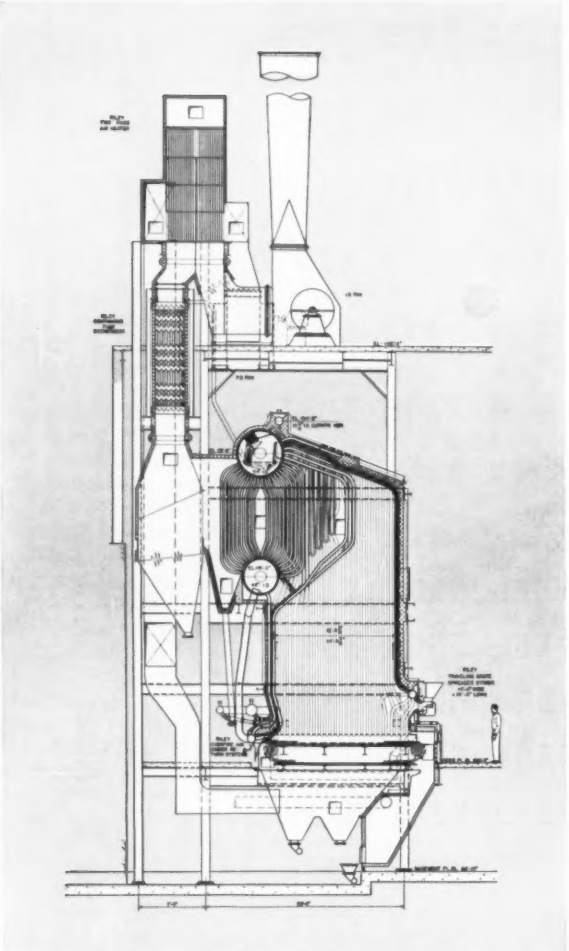

100,000 lb/hr. Riley Single Pass Boiler fired by Riley Traveling Grate Stoker (14′ x 15′); 425 psig., 600 F. Superheat. Designed for restricted area with dust collector in rear of boiler. Combustion gas flows up thru RILEY ECONOMIZER that extends above roof level. Gas up flow continues thru first pass of RILEY AIR HEATER and back thru second pass to induced draft fan on boiler plant roof. Cinder reinjection from dust collectors and boiler hopper produces top stoker-firing efficiency.

* Before modernizing steam generating and utility facilities at its Palmyra, N. Y. power plant Garlock Packing Co. was faced with a multitude of growing problems due to increasing steam loads required for the manufacture of its mechanical packings and to a poor plant heat balance.

Because of increased production, steam demands on existing old and converted boilers had become excessive for proper maintenance. The high price of coal, low efficiency of equipment, the absence of reinjection and heat recovery equipment, and overload of both steam and electrical generating facilities were proving too costly. Then, in 1951 they decided to modernize.

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* *From the Award Winning Entry submitted to POWER editors by Howard R. Spanganberg, Chief Power Engineer — The Garlock Packing Company and Lewis J. Sforzini, P.E. Consulting Engineer, Rochester, New York.*

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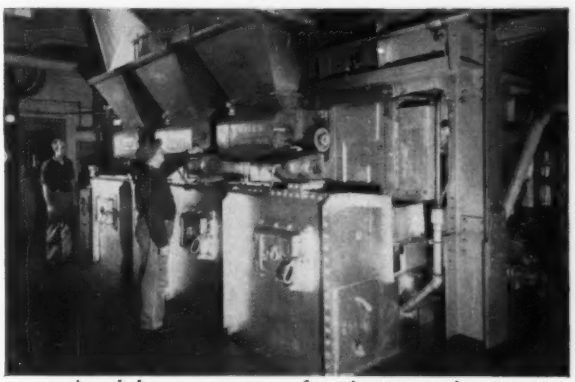

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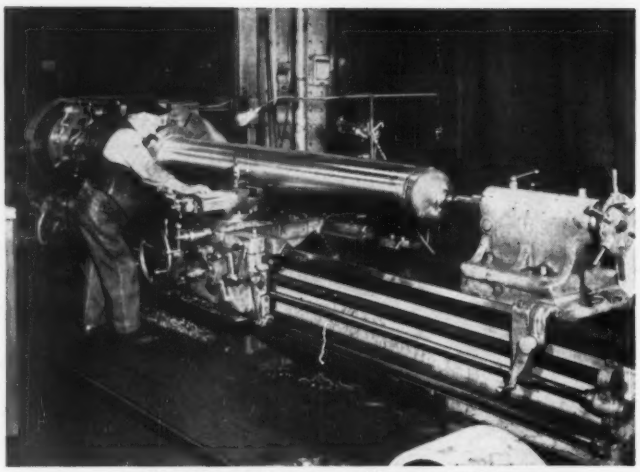
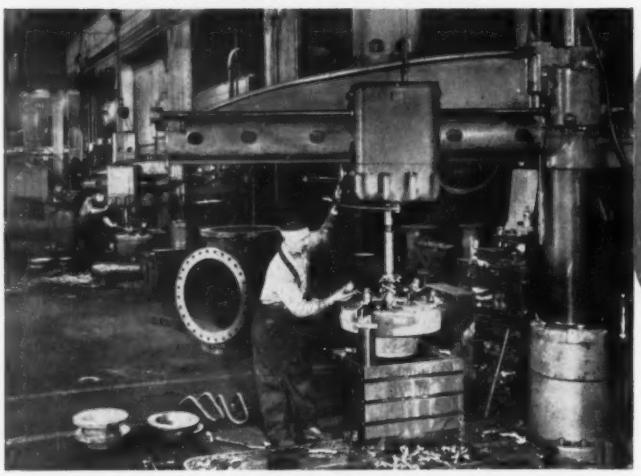
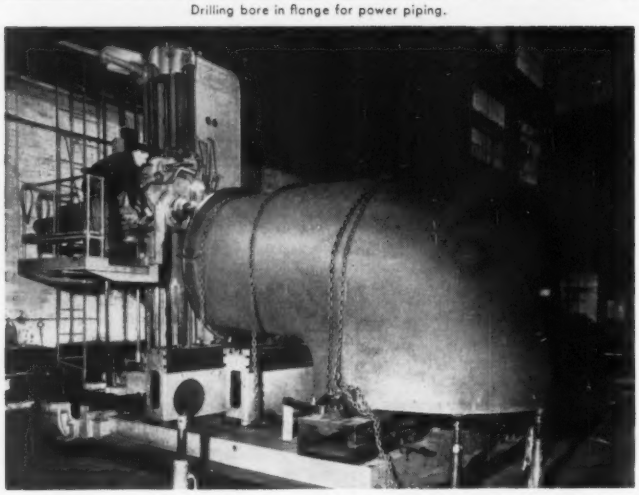


Machining stainless steel pressure vessel for nuclear installation.



Drilling bore in flange for power piping.



Drilling bolt holes in cast fitting for water service.

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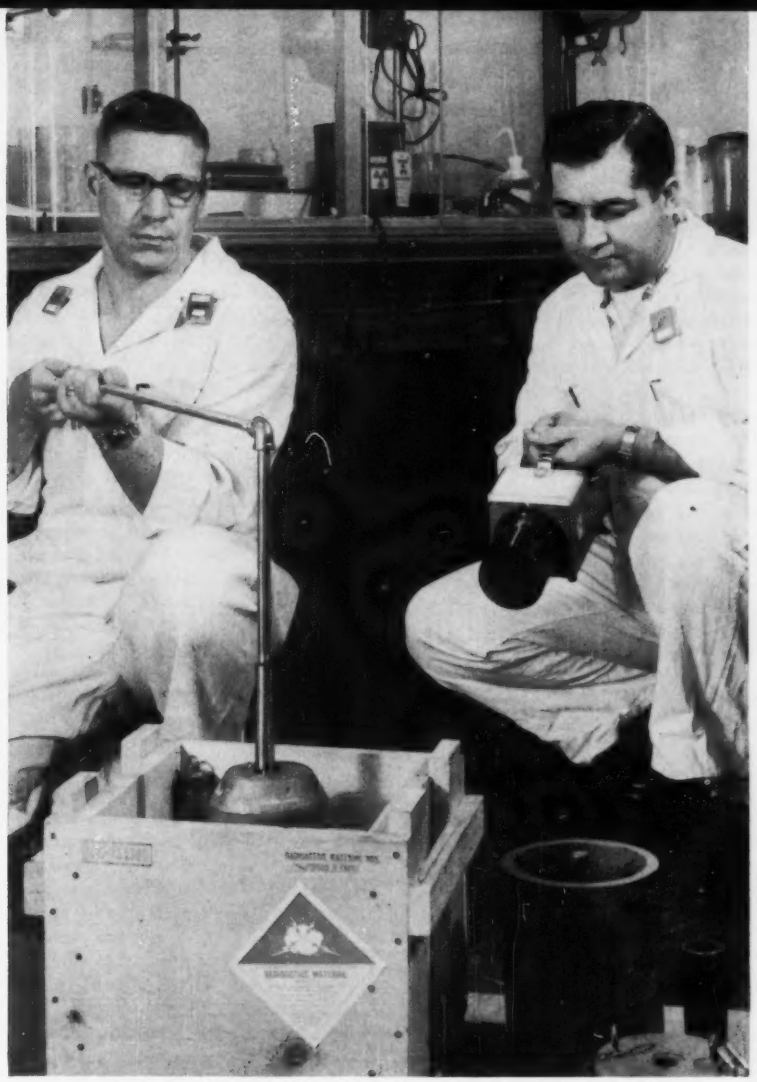


PLANT MEN remove *hot* shipment of...

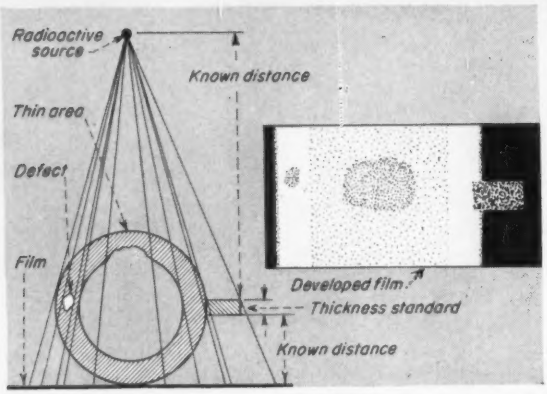
Radioactive isotopes: Your new maintenance tool

By GORDON R MOLESWORTH,
President, Molesworth Associates

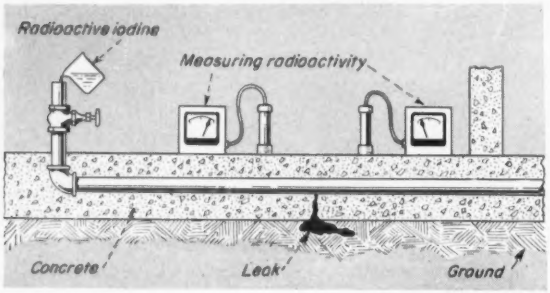
► PINPOINTING a bad water-main leak under a factory's concrete floor was one of first uses of isotopes as a maintenance tool. Tearing up the floor in suspected places would have shut down production for two days. Instead, radioactive iodine was put into water line upstream. A Geiger counter soon showed where radiation collected beneath floor. So instead of stopping production for two days, job was repaired in one day with no work stoppage.

What are radioactive isotopes? They are radioactive forms of the basic elements we all know about—carbon, sodium, phosphorus, iodine and others. We used to believe that all atoms of carbon contained six protons and six neutrons. But research showed that a form of carbon could be made containing 14 particles. Eight instead of six were neutrons, but it was chemically identical with Carbon-12. Carbon-14 atoms were unstable and continually threw off pieces of themselves as they reverted to the stable state.

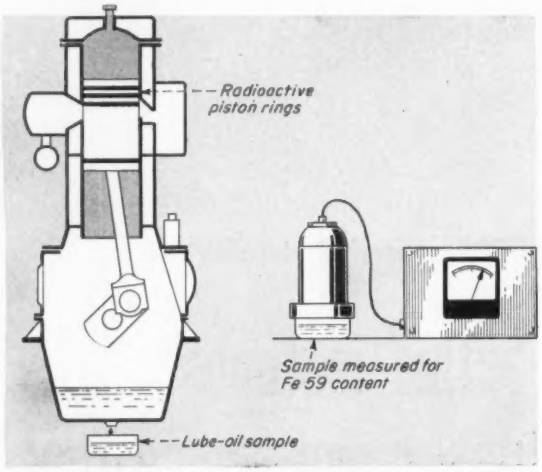
These escaping particles comprised a form of radiation which can be de-



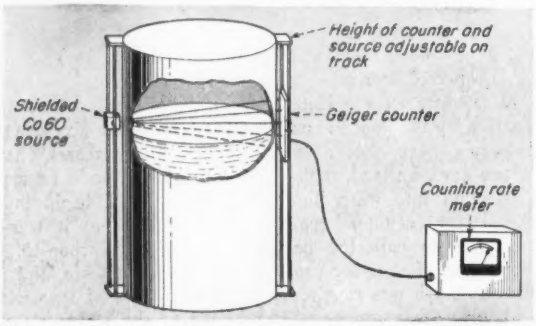
1 Thickness of metals, defects are easy to find. Inspection is reliable; no dismantling, helps to keep the cost very low



2 Leak detection of piping in hard to get at places can save you from tearing up expensive floors needlessly, as shown



3 Friction and lube studies are rapid, simple and economical. Oil can be sampled during operation, metal wear measured



4 Liquid level is measured, automatically controlled and recorded. You need no technical personnel for this job

tected and measured with great accuracy. Thus a radioactive isotope is like a subminiature walkie-talkie radio. It constantly signals its position and its concentration by the radiation it gives off.

In the past 15 years, more than a hundred kinds of isotopes, covering more than 50 of the 92 naturally-occurring elements, have been produced. Since a radioactive form of an element reacts chemically, just as the stable form does, the *hot* atoms of the element can be used in any chemical or physical system. Their movement is traced through many successive reactions—in the human body, in a steel melt, in an involved chemical process, anywhere. Use of this *tracer* technique has solved many tough industrial problems.

Radioisotopes are made in two ways. Most are produced by subjecting target materials to intense neutron bombardment inside a nuclear reactor. Target materials are placed in sealed aluminum capsules about the size of your thumb. These cans are placed in a graphite tray and pushed into the reactor core. After days, weeks or even months of exposure, target materials are withdrawn. They are then separated and purified and either shipped to buyers or stored in a *radioactive bank* for future distribution.

Alchemists dreamed of transmuting base metals into gold. But we transform stable forms of an element into its radioactive counterpart. We even change stable atoms of one element into radioactive atoms of another. For example, Carbon-14 is made of irradiating nitrogen, Phosphorus-32 is made by irradiating sulfur. Even gold can be thus made, but target material is platinum. That doesn't pay off.

Some radioisotopes, such as Iodine-131, widely used in medical research and therapy, are produced by the fissioning of uranium atoms inside the reactor's fuel elements. When Uranium-235 atoms split, two atoms of any of more than 30 different elements are formed. Most of these are very radioactive for varying lengths of time.

Incidentally, each radioisotope has a fixed rate of decay, referred to as its *half-life*. An isotope's half-life is the time it loses half of its radioactivity, varies from seconds to thousands of years. Useful radioactive fission products are reclaimed from spent uranium fuel elements that are removed from the reactor.

More than 100,000 shipments of radioisotopes have gone out from Oak Ridge in the last ten years. There are

over 3000 industrial, medical and research users in the U.S. — hundreds more in 50 foreign countries.

Thickness gages. Isotopes have been put to many uses by plant engineers. Thickness and density gages is single widest use. Here a sealed sample of radioactive material is placed under a moving sheet of metal foil, paper, plastic film, or even sheet steel. Then an ion chamber-type radiation instrument is placed above the sheet. Because radiation penetrating the sheet varies with sheet's thickness, radiation counter accurately measures moving material's thickness.

If linked electronically to the roller controls, you can adjust the roller pressure automatically. That will control thickness of production sheet completely and continuously, 24 hours a day. These gages are accurate to within .5 to 2% of the material's thickness.

Industrial radiography is second largest use, Fig. 1. Variety of industrial castings, fabrications and weldments are X-rayed by the radiation given off from such sources as radioactive Cobalt-60 or Cesium-137. For thickness around ¼ in. of steel, highly portable radiographic units using Cobalt-60 are very effective. Gamma radiography also has promise for the in-plant inspection of industrial equipment during overhaul. This includes motor and compressor shafts, high-speed turbine blades and other parts where cracks might lead to costly breakdowns.

Static electricity elimination is another important use. Radiation flowing from a small isotopic source ionizes the air surrounding it. That prevents static electricity buildup. Such sources placed near rollers, pulleys, etc where static electricity is a hazard, have proved valuable. It also helps to prevent fire.

Leak detection. Isotopes placed in liquids will detect leaks in buried or inaccessible compressed air, water, gas, oil, steam piping, Fig. 2. Savings are many times the cost of isotopes.

Tracing fluids through a pipeline is another highly effective use of radioisotopes. Many oil and pipeline firms mark the interfaces between two petroleum products in transit with a small amount of a radioisotope in solution. Counter, mounted at the storage or switch point, instantly shows end of one product and beginning of next. You can also use this technique to trace or measure flow speed in piping systems. Petroleum firms monitor movement of catalysts in refineries in this way. They make a few catalyst beads radioactive, then record their passage past a certain point in the refinery system.

Luminated phosphors. Phosphor material becomes continuously luminescent when bombarded by particles given off by an infinitesimal amount of radioisotope. U.S. Radium Corp produces a wide variety of radioisotope-bearing phosphor materials. They are used on aircraft instrument dials, for light sources in remote dark areas and for many illuminated markers. Emergency exits, process valves, fire-alarm boxes and other important spots will stand out when power fails.

Industrial research field uses a very large portion of Oak Ridge's isotopic output. Dozens of different radioisotopes are used for hundreds of investigations. Piston rings for automotive and industrial engines have been made radioactive, Fig. 3. After engine runs a few minutes, amount of radiation in oil is measured. That shows which lubricant causes the least wear on engine parts, also which alloy is most wear resistant. You can carry out such a research project in a few minutes. It would take days or weeks by other less effective methods.

This tracer technique also finds effiency of conditioners used for water and various industrial fluids. Many uses for measuring and tracing impurities in plant air and water systems remain to be found and applied.

Liquid level gaging. For years industry wanted a simple, reliable way to find liquid level in a closed tank. Small sealed radioactive source is placed on a tank's side with radiation counter on opposite side, Fig. 4. Source and counter are raised and lowered together. Exact level is known as radiation detected by counter rises where liquid ceases to intervene.

These examples show you plant engineers the potential value of radioisotopes as a tool. So before giving up a tough problem, consider using them.

Where to buy? First determine isotope best for your job, then how much equipment and know-how you'll need. If you need standard equipment, you may buy it commercially as a package. Several companies are in this business. For new or special use, you may need radiation - detection instruments and other items separately. Suppliers are very helpful. You can get valuable information from the Isotopes Division of U.S. Atomic Energy Commission, Oak Ridge, Tenn.

Who can buy? Isotopic material comes from Oak Ridge National Laboratory or from a commercial source. In either case, basis is an AEC-approved application submitted by user. This application requires information about kind and amount of material desired, who will be in charge of its use, what safety measures will be taken and how isotope will be used.

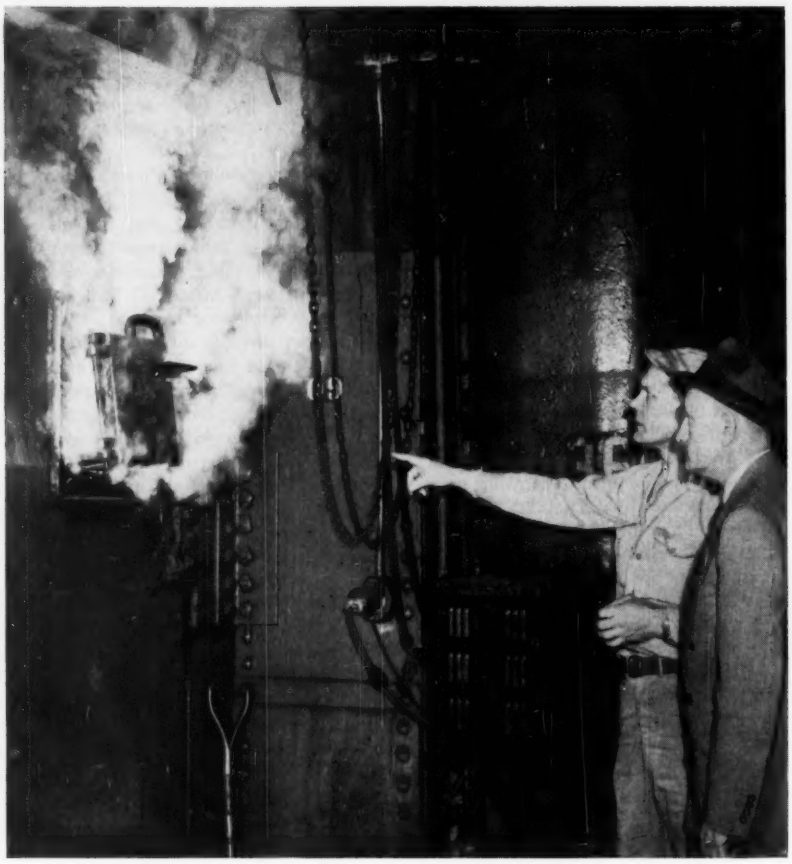
Expensive? Cost of isotopic material varies depending on isotope and radioactivity needed. AEC's isotope prices are based on production costs with the fixed amount of radiation *curie* as unit of charge. So cost may vary from $20 for 100 millicuries (one-tenth of a curie) for Rubidium-86, to $10,000 per 100 millicuries of Antimony-125. Cost of preparation is usually moderate if such service is needed. But it may exceed cost of material itself.

Safety. Degree of radiation hazard varies greatly with material. Materials that emit alpha particles or beta particles (electrons) are easily shielded. These are fairly safe. But don't inhale such materials. On the other hand, isotopes like Cobalt-60 emit powerful gamma rays. You must shield them well to safeguard personnel. Even here, you can easily control hazards by following AEC precautions.

What special skills, equipment and facilities do you need? Range extends from simple packaged static eliminator (needs no maintenance or service for years) to knowledge, shielding and remote handling equipment for *hot* Cobalt-60 or Cesium-137 sources. You should be on speaking terms with technique before using isotopes for research or tracer work. You must recognize the safety requirements, but need almost no equipment other than a radiation counter. And that is not expensive.

Literature. Several good publications will give you information, both general and technical. Government Printing Office will send you the 5-year and 8-year summaries of AEC's isotope program. Five-year summary has complete information on isotopes produced, users of each and how used. Eight - year summary has extensive bibliography. Atomic Industrial Forum, Inc, recently issued a condensed review of isotope program's first decade. This survey is titled *Industrial Utilization of Radioisotopes 1946-1956.*

Even a quick look at some of these references will suggest problems you can solve. Atomic energy in form of radioisotopes can save you maintenance dollars long before atomic power begins flowing through your plant's electrical system. This is your new tool.



By J STEPHEN UNGAR
Asst Chief Performance Engineer
Consolidated Edison Co of N. Y.

Fog—fire-resistant, nontoxic, is new tool to . . .

Find those costly boiler-casing, condenser leaks

► PRESSURIZED FOG, generated from a commercial fire-resistant lubricant, can pinpoint efficiency-killing and costly air leaks. Power-plant offenders are: boiler settings and casings, turbine casings, condenser shells and connected piping.

Boiler casings move continuously because of expansion and contraction from heat intensity changes. Such motion often causes leakage, through settings and casings, which may cut down on overall boiler performance. If leakage aids combustion, that's fortunate, but such select leakage is uncommon.

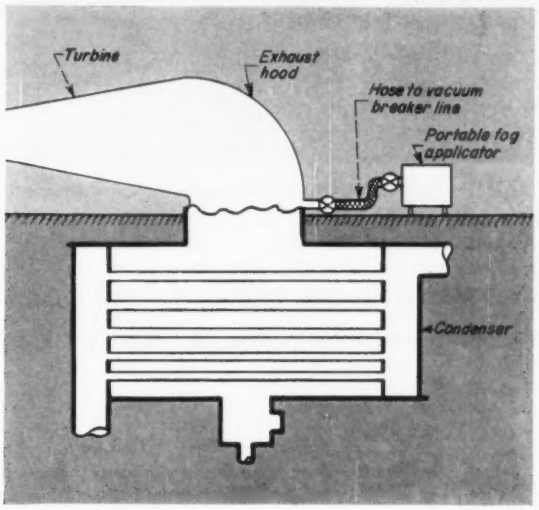
Most leakage ups the load on induced-draft fan or chimney and interferes with admission of air needed for good combustion. Further, leakage can increase fouling rate of heat transfer surfaces and decrease boiler's smokeless steaming capacity. Operators have to be constantly on the alert for casing leaks in order to keep boilers at peak performance.

Many leak-detecting methods take too much labor and time. One such method involves use of lighted candles while pulling a suction on the inside of the casing. It's a tedious process which, by its very nature, discourages those using it.

A less time-consuming and more effective method uses smoke bombs. These are lit in the furnace. Closing the outlet damper forces smoke through any opening in the casing. Big disadvantage is that too much smoke generates in too brief a period. This large volume of smoke seeps through leakage areas so quickly that frequently it obscures actual leak sources.

We wanted a method that would spot leaks quickly and accurately. And we wanted to control the spotting medium

GENERATOR, connected by flexible hose to sealed observation door, fills boiler casing with visible fog. Boiler forced-draft fan builds up slight furnace pressure



TURBINE CASING, condenser shell are subjected to fog pressure of 6 to 9 in. water through hose to vacuum-breaker piping

so it wouldn't obscure visibility around the boiler casing. Further, it had to be fire resistant, explosion-proof, nontoxic.

We did a lot of digging around for the right method and came up with one that involved use of an industrial fog applicator. With this, we generate a visible fog and inject it, under pressure, into the boiler furnace. Pressurized fog seeps through casing openings, reveals them to an observer. Our method can be used on a hot boiler just off the line, or on one that has been idle for some time.

We check boilers for air leaks as soon as they come off the line. This gives the maintenance crew the number and location of leaks found, and they're ready to seal them as soon as the boiler cools. Before boilers go back in service, we use fog again. This tells us whether or not we've done a good sealing job and gives a general appraisal of boiler casing tightness.

Preparing a boiler for testing is fairly simple. Boiler or stack dampers are closed tight enough to permit only slight leakage. F-d fan is rolled just fast enough to build furnace pressure up to about ½ in. water. Fog is injected through a furnace observation door, photo, left. It's necessary, of course, to close all other observation doors and to seal such large openings as the slag taps. Shortly after injection, fog will appear from any existing openings in setting and casing. Observers then mark leak sources.

We get best results when atmosphere around the boiler isn't saturated with fog. To control this, we generate fog for about 15 seconds every two or three minutes. Photo, p 114, shows how this gives us enough fog to reveal leaks without obscuring the source.

We use fog to find condenser leaks, too. Air leakage into a condenser can occur through (1) low-pressure end of turbine casing (2) condenser shell (3) connected piping. It's costly because it hurts condenser vacuum, causes more heat loss to cooling water, cuts turbine output for a given steam flow.

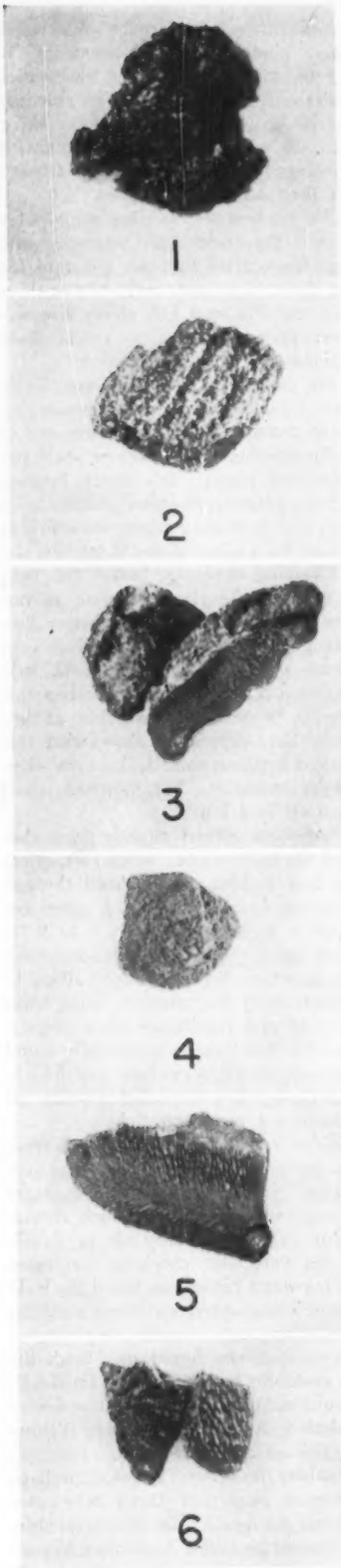
Checking condenser leaks. One way is to flood the steam side up to turbine exhaust flange and let water flow through any openings in shell or connected piping. Remaining parts, subject to leakage, are candled when turbine is in service, preferably at low load. But, experience shows that this method bypasses some leaks, even when they're excessive. Fog, however, spots them all in a hurry.

Technique differs slightly from that used for boiler-casing leaks. We inject fog into turbine-exhaust hood through a vacuum-breaker line. Gas generator supplies pressure of about 6 to 9 in. water in the turbine and condenser. Fog injection is intermittent—about 15 seconds every five minutes. Then leaks show up and results are often surprising. We find leaks in supposedly sound areas. Conversely, we are gratified to find that some suspected sources of leakage are good and tight.

We're well satisfied with results from this method. In several instances, detecting leaks in boiler casings netted us improved combustion which considerably cut the combustible in flyash. In one particular check of condenser cooling-water piping, we found the leakage we'd suspected was impairing the circulating-pump capacity.

As stated, the liquid used with the fog generator is a commercial lubricant. Resultant fog is fire resistant and nonexplosive. As a matter of fact, it'll extinguish an acetylene torch.

Toxicity is low. This was perhaps the most important factor when we selected the liquid from those available. We proved beyond a doubt that, in concentrated or diffused form, the fog is harmless to personnel. The concentration of toxic material falls well below allowable limits for daily exposure.



SAMPLES of untreated combustion deposits are flinty, tough to remove. Others, treated, were blown off with air

SOOTY, slag-blanketed tubes take heavy toll in fuel costs

You're using good feedwater treatment. You don't have any waterside scale or corrosion problems. But . . .

Do you treat your boiler's

► COMBUSTION-DEPOSIT treatment has come of age. Today, it's engineered as soundly and scientifically as feedwater treatment. And it does just as effective a job in its area.

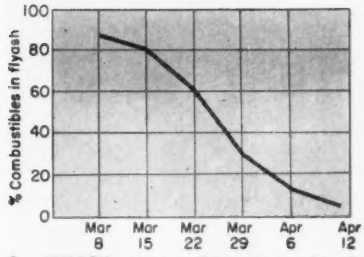
Like its parent, chemical control of deposits was born in an atmosphere of quackery. In the 1800's, people threw table salt in coal stoves to cut soot deposit. It was chance discovery since no control data existed then.

As early as 1856 the British Government granted patents for various smoke preventatives and flue cleaners. In 1876, the U.S. Patent Office issued a patent for a flue-cleaning chemical.

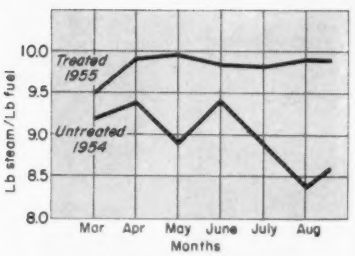
Ideas responsible for some of the early concoctions to control smoke and soot really came from out in left field. It's interesting to note that a number of the magic compounds contained carbon and sulfur—two of the big villains in combustion-deposit formation. Sulfur, in particular, is a major factor in slag formation and corrosion.

Saltpeter was commonly used as an added stimulant. It's a wonder some of the boilers weren't stimulated to the point of leaving the premises, because a mixture of carbon, sulfur and saltpeter adds up to gunpowder.

In addition to common salt and explosive mixtures, such oddities as old rubber boots, oyster shells, tin cans, sugar, and even iron pyrites were heaved into combustion equipment. In the early 1920's, many popular flue-cleaning formulations contained zinc



1 **FLYASH** combustibles drop sharply over the first six weeks of the deposit treatment test. pH of ash increases



2 **EVAPORATION** rates during a six-month test show a large increase over a similar period without treatment

By T T PECK, *Chief Chemist*
Polyphase Chemical Service, Inc

fireside ?

or manganese compounds. Incidentally, most of the patents on these were granted to people living in zinc producing and refining districts.

The U.S. Bureau of Mines made a study of commercially available preparations, plus some 50 or 60 inorganic chemicals. In 1932, it published its survey of chemical control of soot deposits. This showed that a number of metallic salts could cause carbon to burn at well below its ignition temperature.

The bulletin gave a boost to the use of flue-cleaning chemicals throughout industry. Many proved successful in boilers, others didn't fare too well. However, a lot of failures were the direct result of chemical suppliers' ignorance of combustion and boiler operation principles.

Trial and error, nevertheless produced valuable knowledge and experience. For example, it was learned that chemical composition of deposits varied as widely as chemical composition of the fuels used. Also, certain chemical mixtures did a better job than others on combustion deposits. It naturally followed that analysis of a deposit was the first step in determining what formula to use to prevent it. This was nothing more than a transfer of boiler-feedwater treatment experience.

Having formed the basis for success rather than failure in control of deposits, next step meant tackling the major problem of heavy fireside scale and slagging in high-pressure boilers. Up to this time, principal concern was with fireside scale and soot in small and medium boiler operation. At first, attemped chemical control of slag was nothing to brag about. But, as time went by, experience with the idiosyncrasies of high-temperature, high-pressure operation paid off. Today, failure to gain improvement in large steam-generator operation is an exception.

Setting up chemical treatment of combustion deposits in modern boilers calls for a detailed analysis of the offending deposits. And, it's equally important to know all about the boiler's operating characteristics. Armed with these facts, the combustion chemist-engineer writes the prescription for a custom-tailored treatment.

Assuming that treatment is under way, how can we tell whether or not the patient is responding favorably? First, and most obvious, is visual improvement. Slag softens and turns porous. Fire scale tends to peel like old paint. Flyash volume decreases.

Second, use chemical yardsticks. At periodic analysis we find lowered flyash combustibles and higher pH values of flyash. Latter is important from a corrosion standpoint.

Finally, check performance on the basis of instrument readings. Evaporation readings go up, stack temperature readings go down.

Of these methods, instrument readings are considered to be the best criteria of performance because they can be translated into dollars and cents. Difficulty is that boiler-plant instrumentation often isn't complete, or instruments are unreliable due to poor maintenance. Here, visual and chemical determination methods have to be used.

Photo, p 116, shows value of visual method. Combustion - deposit samples are those taken from two 125,000-lb-per-hr boilers. Both were bituminous coal, underfeed-stoker fired with steam generated for both power and heating. Both had heavy slag deposits on refractory walls and superheater tubes—which had to be water lanced about twice a week—and other insulative deposits coated the economizer tubes.

Using one boiler as a guinea pig, a tailored fireside chemical treatment was started. After a 6-week period both boilers were taken off the line. The three samples, photo, p 116, were taken from same areas of each boiler to accurately determine effect of treatment.

Samples 1 and 2 are slag from front walls. Sample 1 (untreated) is moderately fused. It took three men, using pickaxes, two days to remove the stuff from the refractory walls. Sample 2 (treated) could be pulverized by crushing it manually. One man with an air hose cleaned the walls in about 10 minutes. Slag was roughly 6 to 8 in. thick in both boilers.

Sample 3 (untreated) taken from the superheater had the hardness and consistency of ordinary plaster. Sample 4 is a pile of powder brushed from the treated superheater. This film of powder was the only deposit present.

Sample 5 is from the untreated economizer. It took chipping hammers to remove it. Sample 6 from the same area of treated economizer is half as thick as 5, but much softer, and could be removed with an air hose.

Fig. 1 represents the second, or chemical, method of evaluating performance. This graph shows reduction in combustible content of successive samples of flyash taken from another boiler during its first six weeks of treatment. Starting with a reading of 89.1%, the combustible dropped sharply to 7.2%. The boiler is a 110,000-lb-per-hr unit firing bituminous via spreader stoker.

Instrument readings for performance evaluation (specifically, steam production vs coal consumed) show value of this method, Fig. 2. Test unit is a 125,000-lb-per-hr boiler burning a premium bituminous. The fuel had a high ash-fusion temperature. Deposits showed high percentages of boron.

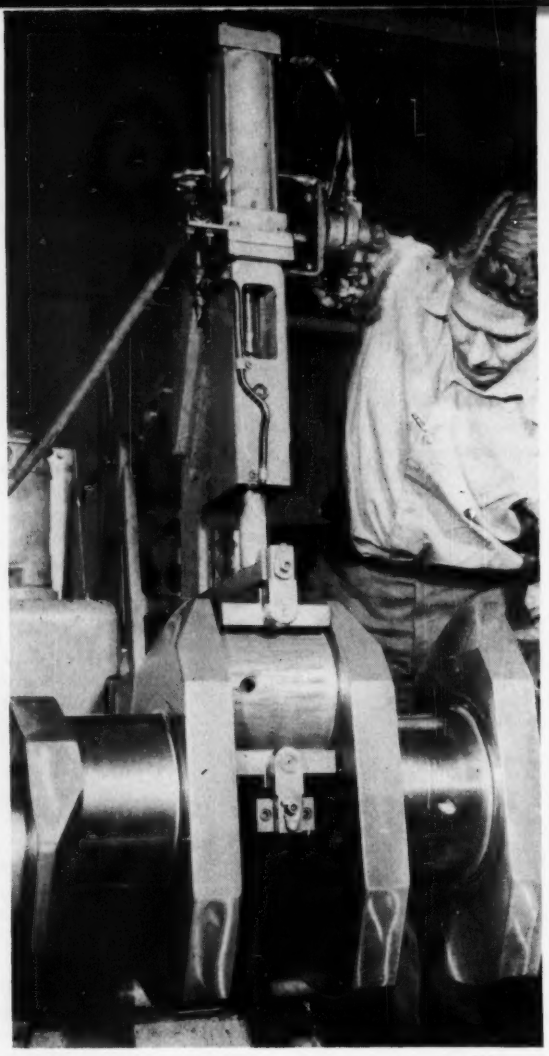
Daily evaporation rate records were compiled for a 6-month period prior to treatment. Similar records, kept during the same months of the following year, showed average evaporation was upped from 9.05 to 9.83. With a net evaporation gain of 0.78 lb, it's estimated that treated boiler saved about 7 tons of coal per day, or roughly 1275 tons during the test period.

Small and medium boiler operations, large steam generators, steel making furnaces, oil refinery stills use chemical control of combustion deposits. It's effective in most operations where fuel used results in combustion deposits.

Chrome coat that shaft now

By J M A VAN DER HORST, *Vice President*
Van der Horst Corp, Olean, N. Y.

- **Chrome plating stretches shaft life**
- **Superfinishing cuts down friction**
- **Same shaft can be rebuilt many times**
- **Bearing, not shaft, may fail**



GREATER BEARING LOADS will be carried by this chrome-plated shaft because the wearing surfaces are superfinished

► MOST EXPENSIVE internal-combustion engine moving part is the crankshaft. And that's one good reason you should strive to stretch its life. Most economical way known today is to plate with chrome.

Chrome of 800 to 1000 Brinell is electrodeposited on wearing surfaces. This gives almost wear-proof life. Thickness of coating depends on shaft size and service, ranges from 0.006 to 0.060-in. on the radius. About 0.001 to 0.002-in. more chrome must be added for finishing. Coating is then lapped to superfinish of about 5 to 10 micro inches.

High-speed engines. Crankshafts in high-speed engines, over 750 rpm, wear most because of high bearing loads. Amount of wear depends on hardness of bearing materials. Lubrication failure, scoring by abrasive particles imbedded in bearings matrix, and fatigue of bearing material all add to the problem.

Chrome-plated shaft has a better chance of surviving these conditions due to its inherent resistance to wear and abrasion. Nitriding and induction hardening are other ways to harden shafts. But once shafts are so treated, it's almost impossible to retreat them after undersizing to repair surface damage. Shafts with surface damage are usually ground to an undersize, necessitating use of undersize bearings. By chrome plating worn crankshafts you can keep standard, design-size bearings in your engine. Besides, chrome-plated shaft is more resistant to wear and scoring than new shafts.

Chrome, with Brinell hardness of 800 to 1000, gives a surface about twice as hard as an induction-hardened surface. Where a shaft has had no bearing trouble, base shaft removal and reconditioning on the manufacturer's tolerance for wear.

Examples: Shaft *X* had bearing trouble, several journals scored slightly. Shaft was removed from engine and damaged journals ground to 0.040-in. undersize to remove the scoring. But when fitting undersized bearings, operator found journals had to be further ground to about 0.060-in. undersize. Reason was that engine manufacturer had only standard bearing undersizes of 0.030 in., 0.060 in. and 0.090 in., with limit oversize of 0.125 in.

Remember, every particle of metal removed affects shaft's ultimate life. In this case it was impracticable to remove an extra 0.020 in. Here, the 0.040 in. removed could be returned by chrome plating to design dimensions. Then, if chrome should wear enough later, new plating could be built up without reducing shaft's metal.

Slow-speed engines. Crankshafts turning at speeds under 750 rpm are less likely to damage from bearing troubles. But, wear and scoring is still possible. Damage is usually

limited to a single crankpin or journal that can be reclaimed with chrome. Then you won't need one undersized bearing in an engine having standard bearings.

Crankshafts in engines burning heavy fuel are exposed to high acidity in lube oil. Chrome resists this corrosion. Bearing load determines type of bearing materials used. So, in high-speed engines with high brake mean effective pressure, it's customary to use the harder bearing materials of tri-metal, etc. Use hardened crankpins and journals with these harder materials. *Reason*: A soft shaft in frictional contact with a hard bearing material is usually damaged badly in case of bearing trouble.

Chrome lends itself very well to new engine crankshafts because: (1) Low temperatures used in plating process doesn't affect heat treatment or property of shaft. (2) Plating to size and superfinishing provides a running surface with a very low coefficient of friction. (3) Chrome resists abrasion particles carried by oil that become imbedded in bearing matrix. (4) If wear tolerances are ever reached, you need only to replate the shaft.

Bearing life is most important. I won't go into seizures caused by lube-oil failure from engine's lube-oil pump. Sure, effects of bearing seizure are all the same to an engine operator. But remember, causes of seizures that take place when there's plenty of lube oil pumped to bearings have mystified many engine operators.

Crankshaft bearings are lubricated by two complementary lube-oil systems. Primary system delivers lube oil from the engine's lube-oil pump to the bearing shells. Pressures range from 40 to 75 psi, depending on engine's design. Secondary system is inside bearings. Here, pressures may be several thousand psi. What should the average oil pressure be in the secondary system? When multiplied by bearing's projected area, it should equal bearing load.

Basically, a shaft rotating in a bearing is a simple pump (viscous drag). The pressures developed by this pumping action are relative to: (1) shaft speed (2) oil viscosity (3) load on the shaft.

Oil pressure, caused by shaft rotation, separates the rotating shaft from the bearing surface opposing it. But, when engine is stopped, journals and crankpins make almost metal-to-metal contact with their bearings. When engine starts, oil pressures generated in secondary lube-oil system must be high enough at instant shaft turns to minimize metal-to-metal contact. Then as shaft speed increases, oil pressures in secondary system increase. So startup is critical moment.

Remember too, the oil pressures developed in this secondary system keep journals and crankpins from centering exactly in their respective bearing bushings. What happens is that shaft rotates eccentric to the center lines of the bearing bushings, in direction of shaft's rotation. So your highest secondary oil pressures exist in an area called the clearance wedge—between shaft and bearing surface where shaft-to-bearing surface clearance is the least. Rotation at this point is in opposite direction as point where shaft to bearing-surface clearance is greatest.

Shaft loading determines dimensions of clearance wedge. As shaft loading increases, shaft is forced nearer to the bearing material, and oil pressure between the shaft and bearing increases. Under heavy loading, clearances between shaft and bearing become very important. If clearances are too large, oil pressure won't develop because of leakage through bearing ends. Be sure to follow manufacturer's recommendations for bearing clearances.

Theoretically, there is no limit to pressure that can be generated within the bearing. Besides, there is no limit to the load that an oil film will support. True, the shaft and bearing will come closer together, but will always be separated by the oil film. This theory holds true on near perfect bearing and shaft surfaces.

Surface finish. In practice, true surface perfection isn't easy to attain by grinding. Examining a ground shaft's apparently smooth surface at high magnification reveals a serrated geometry. It has all the potential cutting characteristics of a saw or file, with no uniformity. This lack of uniformity places a limitation upon amount of pressure that can develop within the bearing.

As the ground shaft is lowered under load, the oil film is loaded severely by the highest serrations on the shaft's surface. This oil film will break through and be punctured. Then the tooth-like projections on the shaft gouge out the softer bearing material. This removal of bearing metal supplements the metal removed by shaft's surface unevenness during the initial rotation on engine startup.

Although, under these conditions, amounts of metal removed are infinitesimal, bearing metal is removed with each revolution under heavy shaft loading. So an engine turning hundreds of thousands of revolutions per day will obviously lose some bearing material each day. Part of the removed bearing metal lodges in the valleys between the high surface irregularities while the rest of it is carried away by lubricating oil film.

Superfinishes. Surface perfection is more nearly attained by superfinishing shaft's wearing surfaces after grinding. The smoother superfinished shaft will permit full loading of the shaft without breaking through the oil film. Your bearing oil pressures will then attain values that will be limited only by overall bearing clearances. All in all, this adds up to efficient, reliable engine performance.

Cylindrical surfaces of a crankshaft are superfinished with an oscillating fine mesh, grit-size abrasive stone. This stone is loaded against the rotating shaft, photo. Abrasive stones, oscillating angularly to direction of shaft's rotation, remove surface roughness by cutting rather than smearing or burnishing. By constantly reversing the abrasive's travel direction, metal lodged against grain is unloaded. At the same time, abrasive removes another particle of metal by cutting action of its opposite side.

Superfinishing is not primarily a dimension producing device. Final superfinishing with a fine grit stone removes only one or two tenths of a thousandth of stock. For a heavier removal of stock, use coarse grit stones. Here the superfinish is often called an OD hone.

Maximum metal is removed during initial operation with the coarse stones. *Reason:* Abrasive stones cut at right angles to the direction of surface scratches. Progressive increase in shaft and stone speeds will increase abrasive's surface speeds. That changes the angles at which grits meet the surface irregularities. Increased speeds also lessen the abrasive's cutting action. So eventually you have a high surface polish.

As opposed to grinding speeds of about 6000 fpm, shaft rotates beneath the superfinishing stones very slowly. Visually, a definite ratio is maintained between shaft rotation speed and number of stone oscillations. This ratio depends on the metal to be superfinished. Low speeds don't produce the high heats of grinding operations. Also, there is no tear out and breakage of sub-surface metal as is the case with high-speed grinding. Surface being superfinished is flooded with lubricant. This not only keeps surface temperatures lower but washes away metal and grit in the process.

In contrast to the line contact made by the grinder while working, the stones used in superfinishing crankshafts control about 25% of the diameter. This large work area conforms to the surface's concentricity—a feature that completely eliminates the imperfections left by the dimensional grinding before you start superfinishing the shaft.

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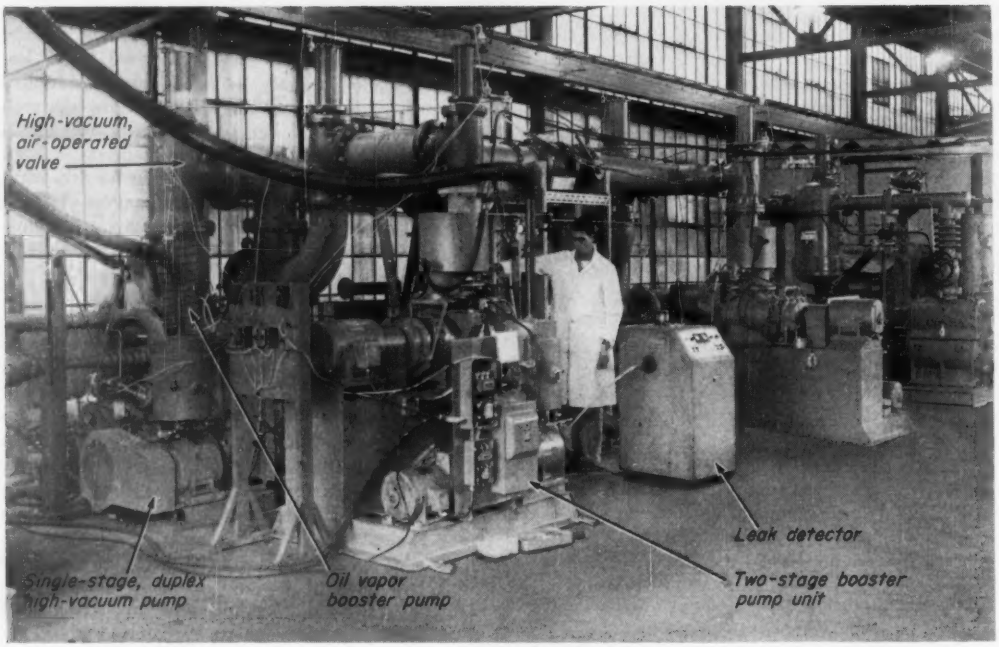
Are you acquainted



HIGH-VACUUM PUMPING SYSTEM is on vacuum furnace. Because leaks are so critical, operator is testing system with a leak detector. Ultimate pressure is 0.1 micron (McLeod), as all gases pass through both pumps

How pump works

► TODAY YOU MUST know how to apply, operate and maintain the many high-vacuum pumps finding their way into industry. A vacuum pump is a low-pressure gas compressor installed to handle a mass flow of gas at a predetermined operating pressure. Because vacuum processing cycles are rapid, these pumps must have a quick recovery time or the ability to draw the system down quickly from atmospheric to operating pressure. In many hookups, oil in the pump must be kept free of contamination. This is done by condensing the vapors.

Unit shown is a positive displacement, rotary, lobe-type, high-capacity booster unit backed up by a rotary cam and piston-type high-vacuum pump. It has a free air displacement of 1230 cfm with lobe pump running at 1800 rpm. Unit's ultimate pressure is 0.1 micron (McLeod) or less.

Lobe-type pump has close clearances so that no sealing liquid is needed internally when running at high-speed at vacuum below 15 mm of mercury. Backing or roughing cam-and-piston-type rotary pump has conventional liquid sealing.

Backing pump roughs out the system to a set vacuum. At that point the lobe-type booster pump starts. From there to the final vacuum, all gases pass through both pumps.

Because the booster pump has no internal liquid sealing, it has no liquid vapors to backstream into the system. So it maintains a high volumetric pumping speed over a wide pressure range. And, because of its large capacity, it also acts as a compressor and prevents backstreaming of vapors from the backing pump.

For very clean high-vacuum, you can add refinements to this pump. One is a cold trap at the inlet of the lobe pump. Another is a cold trap or refrigerated coils between the lobe pump and the backing pump. Time to rough out the system is governed by the capacity of the backing pump. Also, you can get more capacity by adding a separate backing pump. If you do, shut it down when booster pump starts up.

Use extreme care when you hook up piping and insert gages. *Reason:* Smallest air leaks expand to a very large volume in a high vacuum, thus prevent good operation.

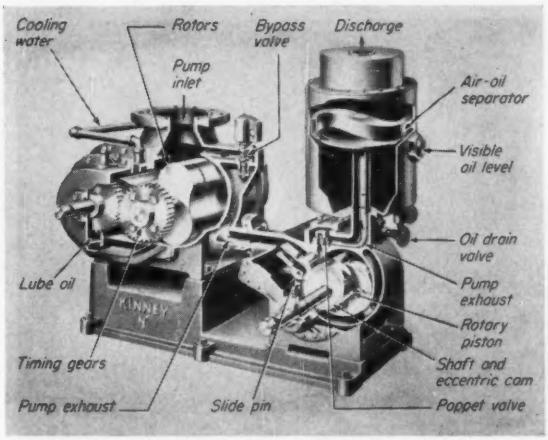
Repetitive operations, in range from a few microns to several hundred microns, are handled efficiently by single-stage oil-rotary vacuum pumps with refrigerated vapor traps. These units pump down rapidly and handle water and other condensible vapors at high speed.

For coarse vacuum processes, simple single-stage oil-sealed rotary pumps can be used without refrigerated traps.

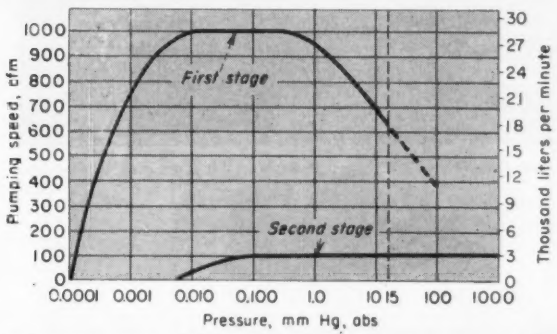
Types of vacuum systems. List of vacuum-pump applications in research and industry is almost endless. But types of systems usually come under one of three classifications: (1) fixed or permanent gases only (2) mixture of gases and condensable vapors (3) mainly condensable vapors.

with high-vacuum pumps?

By STEVE ELONKA, *Associate Editor*



TWO-STAGE UNIT has lobe-type rotors in first stage, rotary piston in second stage. Air-oil separator is important part



PUMPING SPEED CURVE remains uniformly high through the broad pressure range from 500 microns to 10 microns, as shown

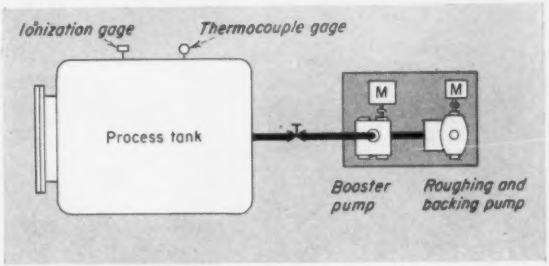
Today, you must eliminate or at least retard the harmful effects of condensable vapors to sealing oil in your vacuum pump because of fast production schedules.

First type system is a *dry* system. Therefore it doesn't present a serious oil contamination problem. Pump with standard equipment is usually OK and doesn't need oil changes often. But, if condensable vapors are problem, a controlled gas-ballasted pump will solve oil contamination. Term *gas ballast* means to introduce enough atmospheric air into pump during its compression stroke to prevent condensation of vapors inside pump. This is done by a manually set valve that controls the magnitude of gas ballast. Thus maximum pump efficiency is assured.

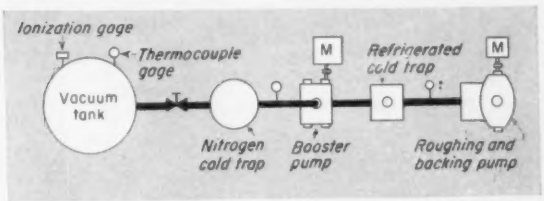
Other types of systems often present tougher problems. There's no cure-all for every contaminating vapor, especially if vapor is miscible with the pump sealing oil.

Complex contaminating problems are solved by (1) controlled gas ballasting (2) stripping air of oil (3) liberation of vapors by vacuum in air-oil separator tank (4) continuous filtration (5) reconditioning oil- and water-cooled condensers or refrigerated traps. Other methods are available. —*Courtesy, Kinney Mfg Div, The New York Air Brake Co.*

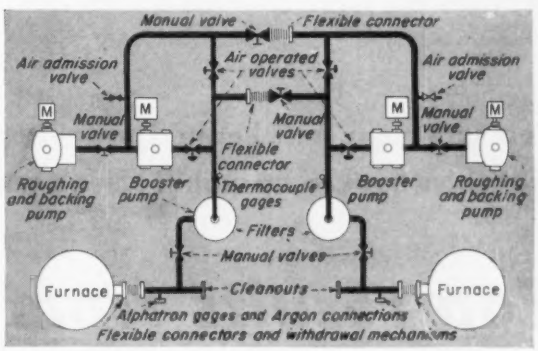
How to apply



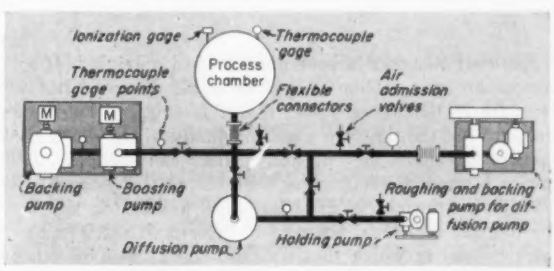
SIMPLE SYSTEM (primary) is used where there are no unusual conditions or requirements. Booster-pump suction is hooked directly to process tank, with stop valve in the connection



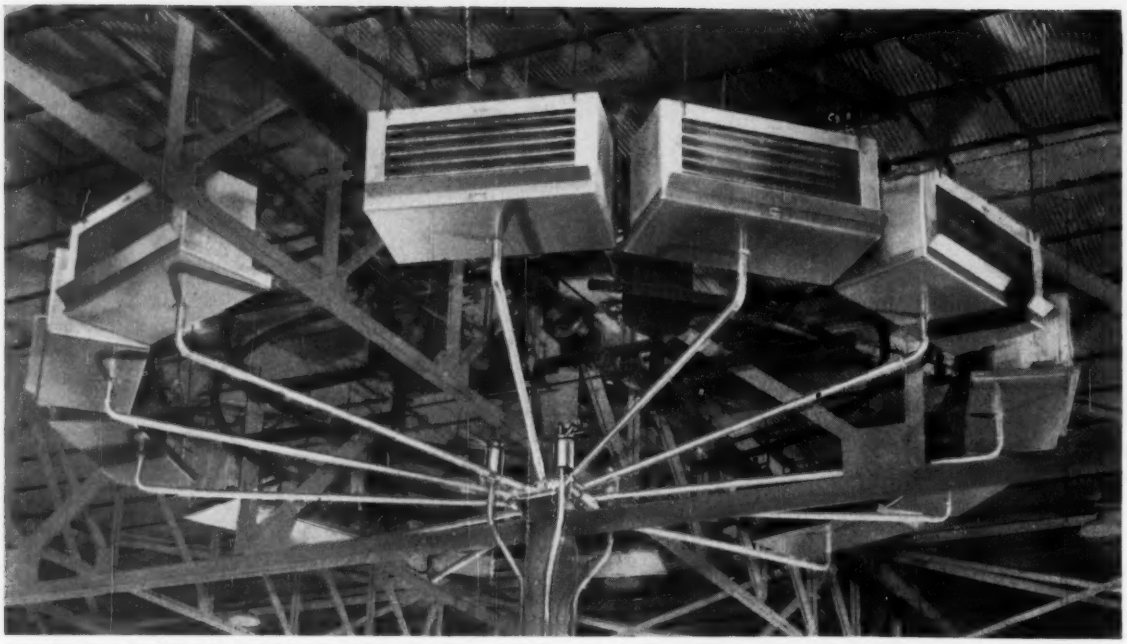
DELUXE SYSTEM has mechanical booster unit to obtain cleanest vacuum. Note the liquid nitrogen cooled trap at inlet of lobe unit and the refrigerated trap interstage between the pumps



TWIN SYSTEM has two complete pump units, either of which can service both systems if needed. Hookup is ideal because you can place both pumps on one furnace to reduce cycle time



FASTEST SYSTEM. Mechanical booster maintains capacity between efficient range of low-vacuum roughing and backing unit and high-vacuum diffusion pump, reducing cycle time



A BATTERY OF UNIT HEATERS is located on a sweeping arc to give the maximum coverage without blowing directly on men

You sure your unit heaters are where they're most needed? Got them hooked up right? Here's what you need to know!

Top results from your unit heater depend on right hookup, location

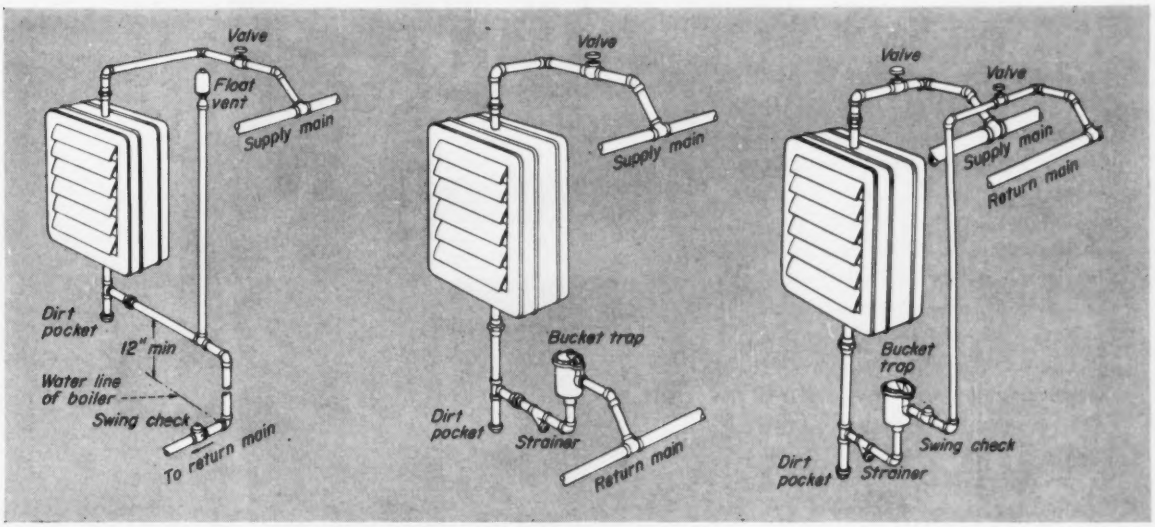
► ARE UNIT HEATERS in your plant hooked up right? If so, chances are you seldom give them much thought. But if traps are in the wrong place, if dirt is clogging lines you probably rue the day you ever bought them. In short, the piping connections to your unit heaters can spell the difference between first-class and poor heater performance.

Guiding principle in installing any unit-heater system: Consider the individual heaters *and* the overall steam or hot-water system in which they operate. Installation of other equipment—process heaters, coils, direct radiators, etc—could have an important effect on how you should hook up these unit heaters that tie into the same supply.

Locating unit heaters. Be sure units blow toward or along exposed walls, preferably striking the walls at a small angle so that heated air exerts a wiping effect along the wall. Carefully working out correct mounting height and distance of throw helps get most good from unit heater's Btu output.

Units shouldn't blow directly on workers. And all frequently opened doors should be blanketed with heat. *Caution*: Place heaters far enough from door opening to avoid directing a blast of heat in faces of men who may be entering. Where you need more than one unit, arrange them so they won't blow against each other. Moving air from one heater should add to flow of other heaters, not fight them.

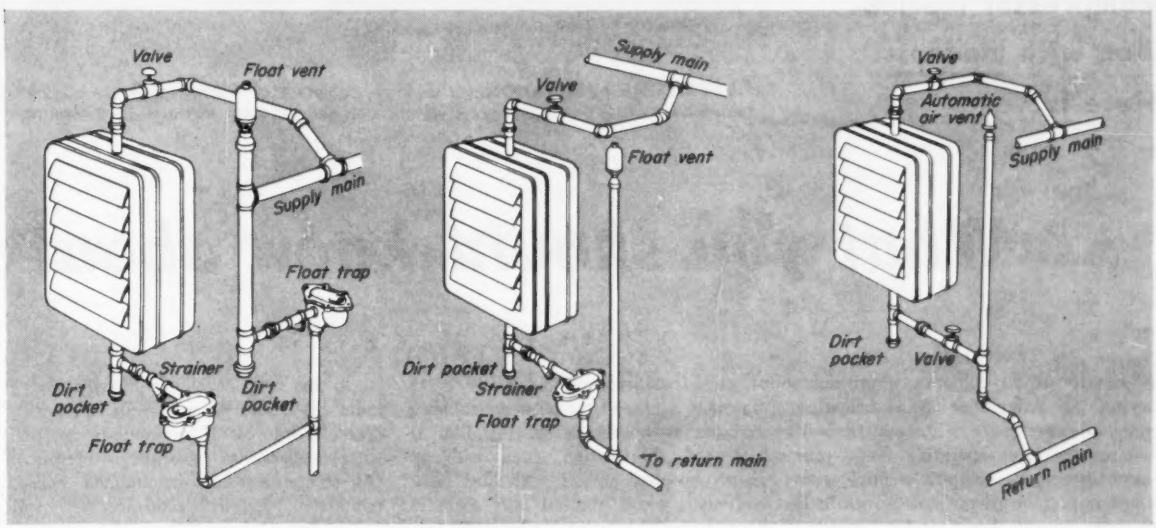
Your heating system type dictates which unit-heater hookup you use



TWO-PIPE steam system requires a float vent above the unit heater; no trap

HIGH-PRESSURE steam system substitutes bucket trap for a float-drip trap

ANOTHER HOOKUP of h-p steam system when supply and return are same level



L-P OR VACUUM SYSTEM uses two float traps and float vent above unit heater

OVERHEAD MAIN and gravity return is one of the simplest unit heater hookups

HOT-WATER SYSTEM, using circulating-water pump, requires no traps, strainers

Hookup tips. Drawings, above, show piping connections for most of the unit-heater systems you're likely to meet. Here are several points that may apply to your installation:

(1) Avoid dripping through unit if possible. When you must drip the main through a unit, pay special attention to return piping and trap size. At worst, you could run into a serious water-hammer problem.

(2) Use thermostatic drip traps only on units of 100-sq-ft edr or less. And be sure to install a cooling leg, at least five feet long, between heater and trap.

(3) Mount float vents at least as high as top of the unit heater. Piping to float vent should be same size as return piping. Install a reducer at the vent. Float vents should close against both air and water.

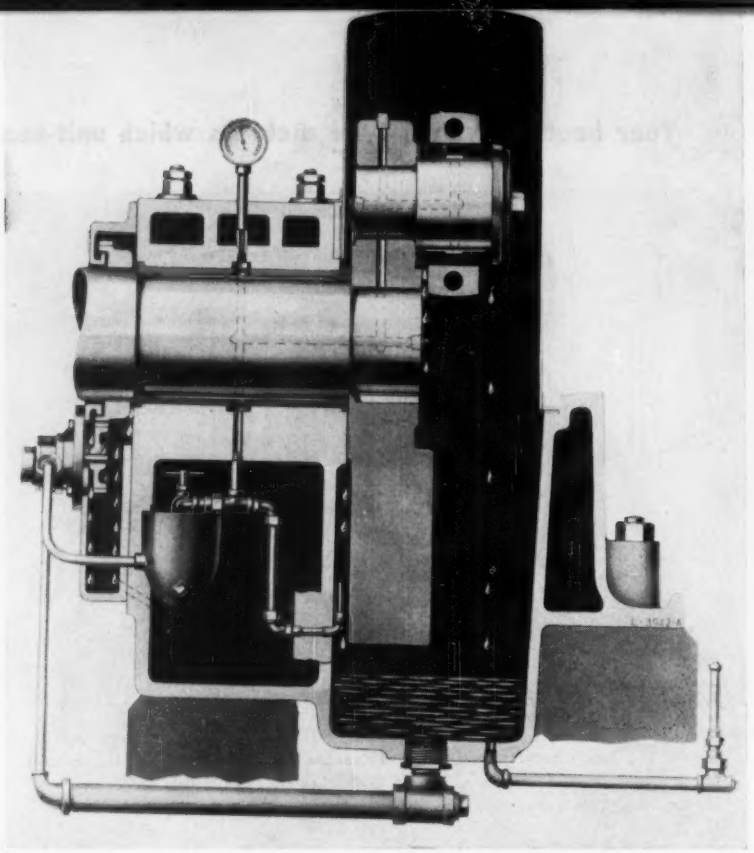
(4) Use a quick vent—closing against air only—at the end of the steam main for venting air.

(5) For h-p work, use a bucket instead of float-drip trap.

Service troubles. Defective swing-check valves cause the bulk of unit heater service trouble. So be sure to choose these valves with care. Pay special attention to the flapper. *Important*: Use swing-joint connections on high-pressure steam installations where expansion and contraction of piping is extreme. Swing joints protect the unit from needless strain.

—Courtesy, The Trane Corporation

Don't kill your air compressor lubrication with kindness. Here is...



FULL-PRESSURE LUBRICATION for a large compressor. Shaft-geared oil pump forces lubricating oil, under pressure, through the oil filter to the main bearing

What you should know about

► EVER STOP TO CONSIDER what you're trying to accomplish by lubricating your compressor? Chances are—if you're like most operating men—your compressor lube setup is a fairly routine operation that you give little thought to—as long as it's working right. But, what does good compressor lubrication *really* try to do?

Briefly, air-compressor lube aims boil down to (1) reducing wear on working parts to a minimum (2) reducing friction and, as a result, compressor power consumption (3) eliminating compressor carbon deposits.

Your compressor-cylinder oil may be fine for meeting the first two aims. Yet it could fall down completely on the third count because of its tendency to carbonize. In contrast, your cylinder oil may be free of carbonizing tendencies but have little lubricating value.

Cylinder oil, to be a good lubricant, must have enough body to support the pressures, temperatures and loading of the moving parts. And the secret of good compressor lubrication is to maintain a film of oil between rubbing surfaces at all times. If the film is destroyed, lubrication goes with it. Thus choosing an oil with the right body is a must. An oil may seem to have the right body at atmospheric conditions but when you apply heat it becomes too thin to maintain a film.

Why is carbonization bad? Largely because carbon deposits interfere with smooth compressor-valve operation. What's more, these deposits often become so hard they form an abrasive. *Result*: Excessive wear of cylinder wall.

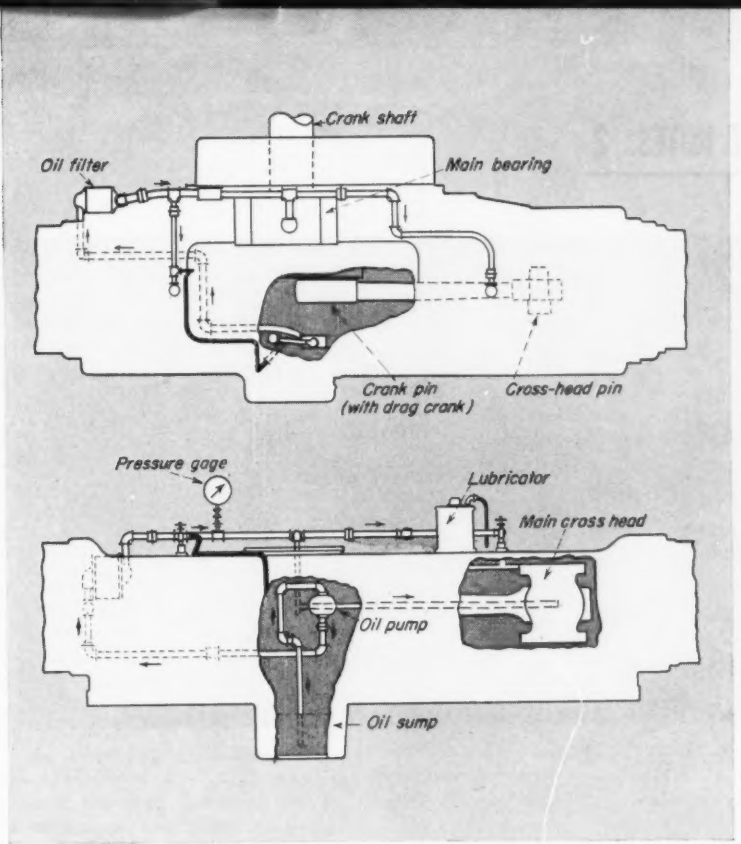
When carbon deposits stay under the discharge valves, hot discharge air leaks back into the compressor cylinder, boosting compression temperature substantially. When this happens, cylinder carbon deposits increase, further boosting leakage through valves. Snowballing effect of carbon deposits causes temperature to climb rapidly.

Lube oil can carbonize for a variety of reasons. Often, oil is a compounded stock that will carbonize heavily. Cylinder oil should be a straight run mineral oil, free of all compounds except where substantial moisture is present. Oil companies can recommend compounds to cope with moisture.

Too heavy lube oils don't atomize readily, remain too long on hot cylinder walls and bake down to sticky deposits. You're likely to run into this headache if you choose a very high-flash-point oil. High flash points go hand-in-hand with heavy-body oils. But the average compressor cylinder doesn't require very high flash point.

Usual discharge temperature of a 2-stage compressor is about 250 F. In a single-stage machine, it rarely exceeds 375 F. Cylinder walls, because they're water jacketed, have a much lower temperature. Thus, a 375-F flash point oil generally yields much better results than one of 500 F—both for single and 2-stage machines.

Use of too much oil is one of the most common causes of faulty lubrica-



OPPOSED-FRAME, four-corner compressor gets full-pressure lubrication via piping system above. Oil is delivered through the drilled channels directly to the bearing

For non-lubricated compressors...

As the name implies, non-lubricated compressors are built to operate without lube oil. Manufacturers design these units so that rubbing surfaces between piston and cylinder and between piston rod and packing, don't cause excessive wear, friction. *Result:* Oil-free compressed air.

Compressor uses piston and rider rings of hard carbon to prevent contact between metal surfaces of piston and cylinder bore.

Caution: Naturally you can't expect oil-free piston rings and rod-packing rings to last quite as long as lubricated parts. Also, maintenance costs are slightly higher for oil-free designs.

your air-compressor lube system

tion. Exact amount varies, depending on oil characteristics, installation conditions. It's probably safe to say that 75% of today's compressors get more oil than necessary. Important point: Don't judge the amount of compressor-cylinder oil you need by the amount your steam engines may use. Steam-engine lube oil is continually washed off cylinder walls by wet expanding steam. In the dry cylinder of an air compressor, oil adheres to walls until it vaporizes, passes through discharge.

It pays to use oil liberally when your compressor is new—or until cylinder glazes. Then reduce quantity radically. Here are some figures you can use as a guide for average operating conditions after cylinders have become well glazed: 9 x 9 single stage, about 2 drops per minute; 14 x 13 single stage, 3 to 4 drops per minute; 26 x 18 single stage, 6 to 8 drops per minute. If you're not sure of right amount for your compressor remove a valve to examine cylinder wall. If wall has an oily film, quantity is OK. If surfaces are dry, increase feed. If cylinders show excessive lubrication, cut back feed.

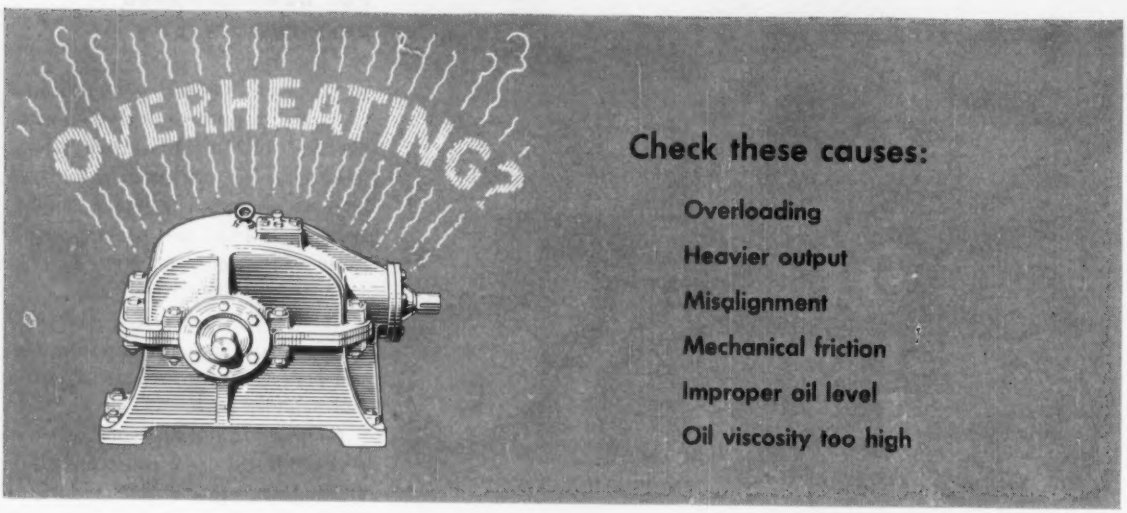
Judging cylinder lube oil quantity incorrectly can lead to major headaches. Here's what happened in one case: Compressor was given so much oil it spoiled the product manufactured. A study showed that a 7x7 compressor was getting 15 drops per minute. One drop per minute would have sufficed.

If you're using a *glycerine feed* lubricator, remember, one drop from the glycerine feed type is equal to several drops from ordinary types.

Lubricating gas compressors present special problems. Many gases tend to combine with oil, making it tough to maintain oil film on the mating surfaces. Often, when you compress wet gas (with jacket-water temperature considerably lower than inlet-gas temperature) lube oil washes off the surfaces by condensation on the cold cylinder walls. When this happens, you should arrange to heat jacket water until inlet-water temperature is as high as inlet-gas temperature, but not above 120 to 130 F. If cooling water temperature pushes into this range, you'll need to circulate relatively large quantities. But heating water is a better practice than throttling outlet water to maintain desired outlet-water temperature. Throttling results in sluggish circulation, cold spots on the cylinder where jacket water enters.

Lubrication can be a real headache if you're compressing a wet corrosive gas. Keeping corrosives under control is a tough problem even when gas is dry. Solving such problems call for the services of a qualified specialist.

If you're running a compressor or vacuum pump that handles a saturated mixture of slightly corrosive vapors, your first step is to trap out moisture at the suction. Also consider installing additional lubrication directly into the suction pipe at the compressor cylinder. —*Courtesy Worthington Corporation.*



Watch for lubrication problems when gear reducers overheat

Your plant may never have a hot gearbox or an incorrectly-marked oil level. Yet these problems often come up in a lubrication engineer's job. Here are three cases that shed light on common gear lubrication problems

By **SIM JESTER**,
Gulf Oil Corporation

► FOLLOWING CLUES to find the cause of gear trouble is one part of my work. No two cases are alike; each presents a different challenge. Take these cases I had several years ago.

Case 1: I made a lubrication survey at a plant rolling brass strip. There were eight medium-sized, two-high rolling mills, most of them with enclosed-spur or herringbone mill drive gears.

I recommended reducing the number of lubricants used in the plant. This involved switching some gears to different oils at the next shutdown.

The master mechanic was hesitant about changing, but he went ahead as advised. He met no difficulty until the men changed oil in No. 4 mill drive gears. These gears were powered by a 150-horsepower motor.

Gearcase overheated. By Friday afternoon, the gears were practically "burning up." Plant closed down over the weekend, so I went there Monday morning to find out what had happened.

Oddly enough, gearbox temperature was perfectly normal. I felt all the bearings and everything seemed OK. Master mechanic said the gears didn't heat up until the mill had been running for some time, so I came back in the afternoon. There was still very little change. Mechanic insisted that gears would heat up by the week's end.

He had withdrawn a sample of the heavy lead naphthenate compounded, extreme-pressure gear oil I had recommended. It was normally black, so there was little to gain by looking at it. I was sure it would do a good lubricating job. The slight difference between the old and new oils could not account for the condition reported. Drum from which oil was taken was marked with the correct brand.

Gearcase nameplate was stamped *Capacity 54 gallons.* The men had emptied an entire 55-gallon drum into it. Since 55-gallon drums are usually filled (and marked) to 53 or 54 gal-

lons, there wasn't much chance of their putting more than that into the housing.

A casual remark put me on the track. The master mechanic said, "What's the matter with your oils? The same thing happened last time we changed oil."

I knew it couldn't happen to two different oils and be the fault of the oils alone. So I began to ask some questions.

"Did the gearcase leak at all?"

"No."

"Did you add makeup oil?"

"Not that I know of."

"How much of a sample did you draw?"

"Five gallons."

"What's the oil level now?"

"Can't tell you. It's still above the oil-level plug."

An arrow on a plate beside the top plug indicated oil level. The men opened the plug and drew out three more gallons before flow stopped. So housing had been filled at least eight gallons above indicated level. There was another plug about two inches lower. Evidently, level was intended to be between the two plugs. Oil should flow from the lower but not the upper one. I recommended installing two small try-cocks to simplify checking.

The cause. By this time I had discovered the real reason for overheating: gearcase was too full and the higher oil level caused excessive churning. Energy absorbed by churning turned to heat. There was no way to cool gears, so oil temperature rose. After several days of continuous operation gears practically burned up. The same thing had happened last time they changed oil, but someone had probably corrected it without saying anything about it.

The trouble actually resulted from a mistake made when gears were built. Either someone miscalculated housing capacity, or digits were transposed in stamping the nameplate. Forty-five gallons, not 54, would have given about the right oil level.

Drawing off the sample reduced heat developed by churning. I recommended they maintain the level between plugs and ignore quantity stamped on the nameplate.

Don't assume that this bloodletting will correct all cases of gear overheating. Trouble can arise for any number of reasons. Before we hit on the right solution, we explored several other possibilities, such as overloading, heavier production output of the mill, misalignment, mechanical friction. When you run into trouble check with your gear manufacturer or an experienced lubrication engineer before making any drastic changes.

The right oil level is important for all enclosed gears. Many years ago, gearcase bearings had separate oil cups or grease fittings. Now most housings are designed so gear oil also lubricates bearings. If there is an oil pump, bearings get adequate lubrication. But many gears are oil-bath or splash lubricated. Too low a level may cut down flow to bearings. For best operation, determine correct level and check it weekly, or monthly, depending on unit's size and severity of operation.

Case 2: An upper New York State paper mill modernized its No. 1 paper machine by installing five enclosed, oil-bath lubricated, spiral-bevel gear sets driving sections of the machine. These replaced old, open wood mitre gears. Reducers were all of the same make and type, but of slightly different sizes. Oil level was indicated in an L-shaped standpipe shipped separately and installed by removing a pipe plug in the housing base. An arrow pointing to a mark in the vertical pipe showed correct level.

Unfortunately, standpipes became mixed up and disassembled from their lower fittings. After installation, some arrows pointed up; some pointed down. No one knew just what oil level should be maintained.

To find out, a list of the serial numbers on each unit was sent to the manufacturer. He supplied measurements in terms of distance below the output-shaft center line. Some levels were higher than normal, because the reducers turned comparatively slowly.

Manufacturer also advised that the instructions forwarded with gears, and probably subsequently misplaced, stated that standpipes should be installed with all arrows pointing down.

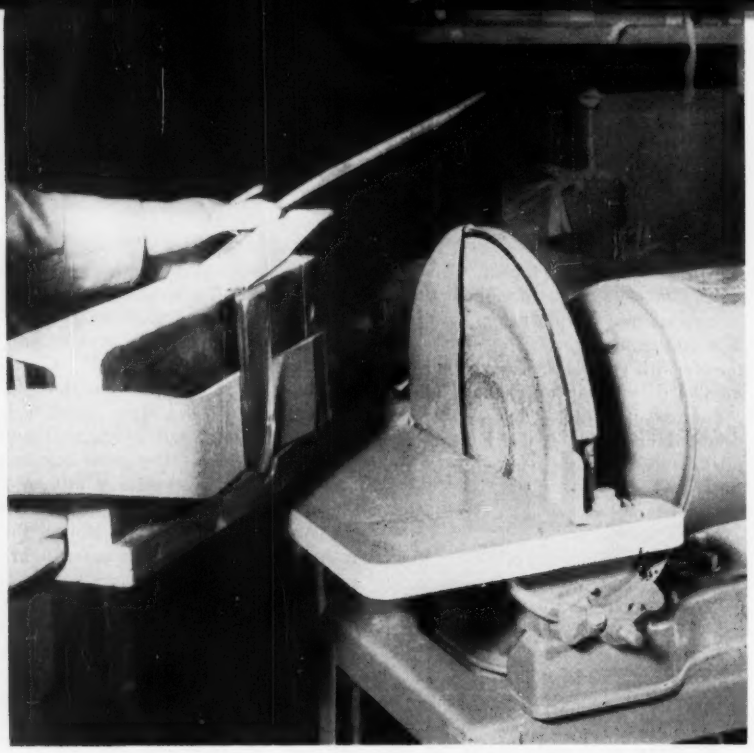
While standpipe arrangement is common, I prefer having the manufacturer mark the right level on gear housing. This avoids field-assembly errors.

Case 3: A manufacturer of rubber tires had a number of large herringbone reducers driving rubber mills. These reducers ran pretty hot, probably 140 to 150 F. The operators realized such temperatures were normal at times, and used a very heavy oil. While the machine was heavily loaded, conditions did not justify such an oil.

In this particular case, I recommended a somewhat lighter oil. I felt that using too heavy an oil developed excessive heat. Operators were surprised to find that, after they drained these gears and refilled them with lighter oil, housing temperature dropped about 20 F.

No two situations are exactly alike. Lubrication engineers need a thorough understanding of principles involved, coupled with experience gained in many different types of plants. Experience frequently helps an oil-company engineer put his finger on a solution that maintenance personnel have been seeking for some time.

". . . a nice hand for our volunteer."



SCARFING CORK GASKET with a sanding wheel to obtain a smooth taper on ends of gasket sections. Jig, made of steel channel and wood, holds the gasket firmly

How to install transformer

► ALL OPENINGS in transformer tanks, with the exception of ventilators, must be closed tight to prevent leakage of oil or gas and entrance of water. Ventilators are designed and located to prevent entrance of moisture. If you've had to open a transformer tank for repairs, tests or relocation, be sure to obtain perfect seals when reinstalling covers and fittings. If the gasket has been damaged, use a new gasket properly cemented in place. Always clean the surfaces thoroughly before applying cement. Remove all traces of paint, oil or other foreign substances. No cement is used on gaskets around no-load tap changers or switch shafts. Give careful attention to preparing and placing gaskets and to tightening bolts.

It is always advisable to follow the manufacturer's recommendation when selecting gasket materials, although a variety of materials are satisfactory for oil-filled transformers. In the case of askarel-filled transformers, selection of gaskets and gasket cement is very critical. Only materials recommended by the manufacturer should be used. Failure to follow the manufacturer's recommendations may result in leaks and ruin the askarel and possibly the transformer itself. Suggestions for handling commonly used classes of gaskets follow.

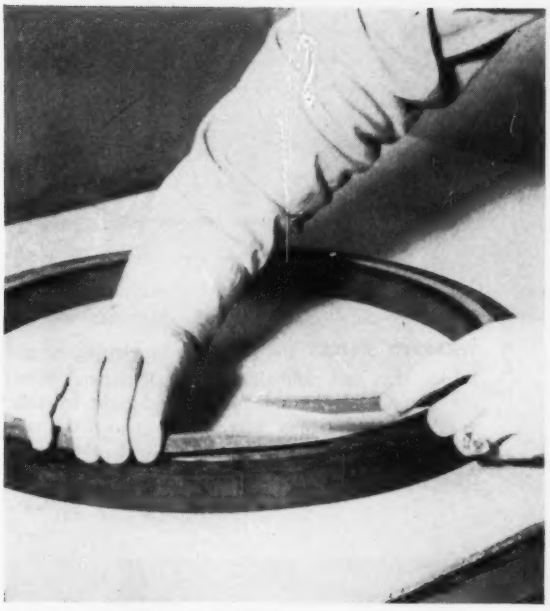
CORK GASKETS. Cover gaskets on small power transformers are usually made of ¼-inch thick cork. Cut cork gaskets the full width of clamping flange. Make angle pieces for sharp corners. Cut gaskets so joints will lie between bolt holes. Always use scarfed joints.

After removing paint and scale from surfaces to be clamped, clean them with carbon tetrachloride or denatured alcohol. Brush a uniform coating of gasket cement on the gasket seat (flange) and underside of the gasket. Allow cement to dry partially, but to remain tacky (air dry for 15 to 30 minutes), before placing gasket in position. Next, apply cement to the top and edges of the gasket and mating flange surface. Allow to become tacky and then place mating flange in contact with gasket.

Insert bolts in holes, apply nuts and lockwashers. Clamp flanges together by a progressive partial tightening of the nuts so as to obtain a uniformly distributed pressure on the gasket while pulling down. Go around the bolt circle several times. After 12 or 24 hours, tighten the bolts again. *Do not allow oil to come into contact with gaskets until cement is thoroughly dry.*

CORK NEOPRENE GASKETS. When cork-neoprene gaskets are used, amount of gasket compression is limited by metal retaining rings on flange surfaces or by flange surfaces themselves. In most cases a retaining groove is provided in one of the flange surfaces to receive the gasket. When it's impractical to provide a groove in the flange, retaining rings are welded to flange surface. Gaskets should be about 50% thicker than groove of retaining rings. When flanges are pulled up tight and metal-to-metal contact is secured, gaskets are compressed 25 to 40% (usually about 33%).

Special cement made for cork neoprene should be used when assembling flanges with cork-neoprene gaskets. The same general instructions for installing cork gaskets apply, except that the bolts should be tightened until metal-to-metal contact of flanges prevents further tightening. If you have to make a joint in a cork-neoprene gasket, neatly scarf both



ATTACHING CEMENTED JOINTS in a cork-neoprene gasket. Finished joint must have same dimensions as the rest of gasket

SCARFING BUNA-N GASKET with sanding wheel. Gasket is held in a slotted stick, making it easy to get correct taper

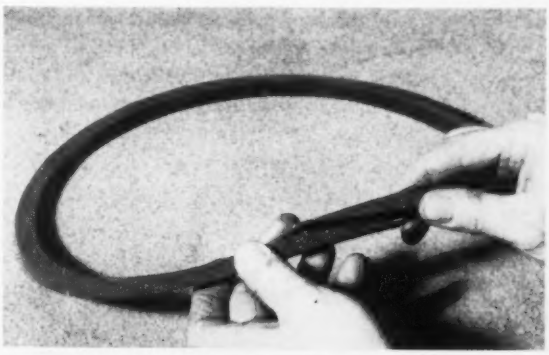
gaskets

ends on the diagonal for a distance at least four times the gasket's thickness. It's advisable to sandpaper the cut after you make it to be sure both surfaces are smooth and have the same taper. Apply a coat of cement to both surfaces of the cut and allow pieces to dry separately for one hour. Apply a second coat to both joint surfaces when underside of the gasket is coated for placing in flange. Let it dry. Avoid making scarfed joints at bolt holes.

BUNA-N RUBBER GASKETS. Handhole gaskets are sometimes made of square buna-N rubber, and are retained in grooves. You don't use gasket cement with buna-N gaskets except at scarfed joints. The surfaces that are to clamp the gaskets should be free from all foreign substances. You can use carbon tetrachloride or denatured alcohol for cleaning recesses or flange surfaces.

To make a scarf joint in buna N, scarf both ends neatly for a distance at least four times the gasket's thickness. Sand scarfed surfaces until they are perfectly flat, then wipe them with a cloth dampened with alcohol. Apply an even coat of gasket cement (such as Minnesota Mining Company's *3M No. EC826*). Allow to air dry for 10 to 20 minutes, until the surface becomes tacky. Bring scarfed joints together and press firmly by hand to remove any air bubbles. There should be no gaps at either end of the scarf. Clamp the joint firmly without causing excessive distortion of the gasket and allow it to dry for at least four hours before removing the clamp. Don't use gasket for at least 24 hours.

If you are going to store spare buna-N gaskets, be sure to keep them in a cool, dark room. Gaskets may be damaged by temperatures higher than normal for transformers.



INSERTING CORK-NEOPRENE GASKET in retaining ring to determine if finished gasket with scarfed joint fits correctly

SCREW JOINTS. Before making screw joints, inspect both male and female threads closely for damage. Clean threads thoroughly with benzene to remove oil. Brush cement on the male threads only. Assemble male and female threaded fittings by hand to distribute cement into the female threads. Take fittings apart and apply another coat of cement to male threads.

Reassemble, tighten properly for a permanent joint. If it has been necessary to revolve a valve or pipe, uncouple the joint completely and remake it as described above.

Adapted from Moloney Electric Company's Power Transformer Instruction Book.

Plant

Electrical

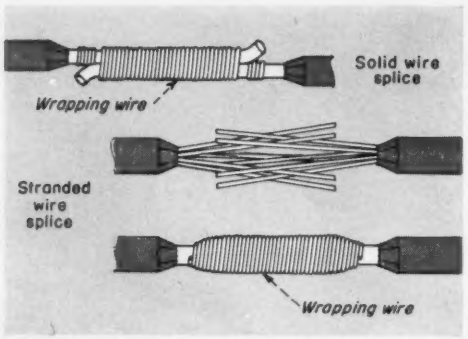
Fact File

NO. 10 SPLICES

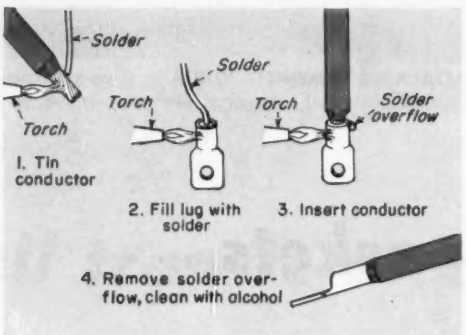
7 ways to splice wire and cable

By NORMAN PEACH, *Assistant Editor*

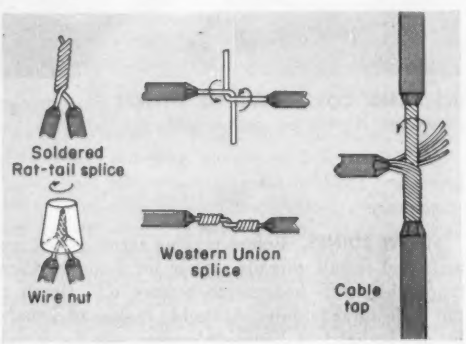
► GOOD ELECTRICAL CONNECTIONS are essential to a smooth-running plant. There are many ways to make splices, especially since bolted and compressed mechanical terminals and connectors are being made in an ever greater variety to meet all needs. They reduce size of the splice and time required to make it. Here are some methods that electricians have been using successfully for several years.



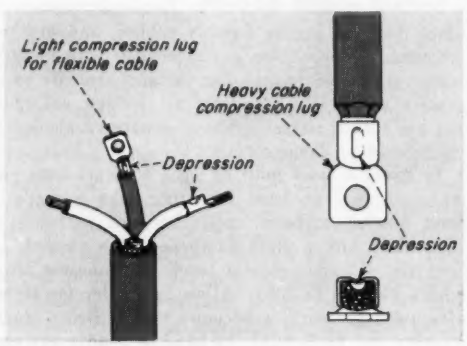
2 **WRAPPED SPLICES** are good for heavier wires and cables that are difficult to twist together. Wires are placed side by side and bound tight by thin, bare or tinned copper wire. Trick is to make sure solder flows into all spaces between the wires. Apply a noncorrosive flux before you bind them.



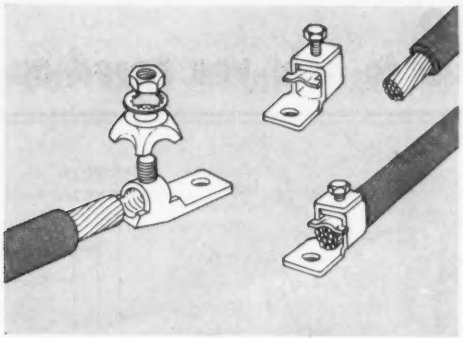
3 **SOLDER TERMINALS** are applied by tinning conductor, then filling cup with solder. Insert conductor slowly so solder can penetrate between strands. Hold lug so solder doesn't overflow on contact surfaces. Don't overheat insulation. Chill lug with wet rag to speed setting. Clean and polish terminal.



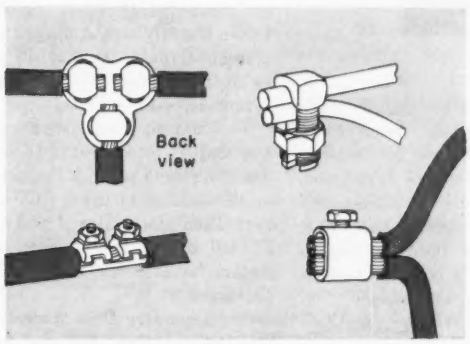
1 **TWISTED SPLICES** can be used where wire size permits using plier for small diameter bends. Except where wire nut is used, splice should be soldered after wires are twisted tight. Right size wire nuts are needed to be effective. Always shave insulation so that wire won't be nicked and later break off.



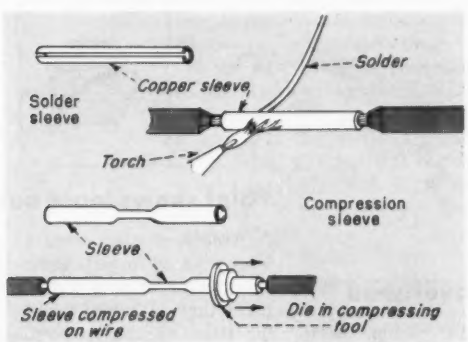
4 **COMPRESSION TERMINALS** are made for a variety of types and sizes of stranded wire and cable. Smaller sizes are attached with a hand tool; largest use hydraulic unit. Impression forces strands tightly together, gives good contact if proper size lug is used. They're quick, clean and easy to apply.



5 **BOLTED TERMINALS** can be put on almost as fast as compression type. You have to use a little judgment when you tighten them, but they're valuable where compression tool is inconvenient, or number of terminals doesn't justify investment. Bolted terminals are bulkier than solder or compression lugs.

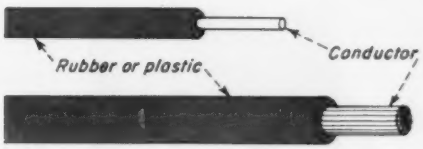


6 **MECHANICAL CONNECTORS** are growing in popularity for wire sizes from AWG No. 12 to 2000 Mcm. They can be made much faster and are generally smaller than soldered splices. They're favored for aluminum; special aluminum to copper connectors are made to prevent electrolytic action.

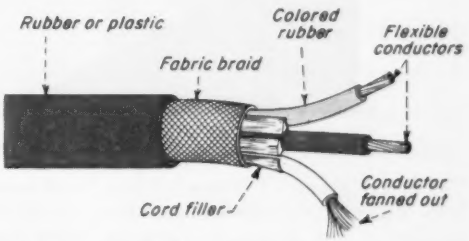


7 **SLEEVE CONNECTORS** can be advantageous where a small-diameter splice is important. Compression sleeves, which are applied with a special tool, make splices strong enough for suspended cables. Solder sleeves should be tinned, wires inserted and solder fed through the slot on top until sleeve is filled.

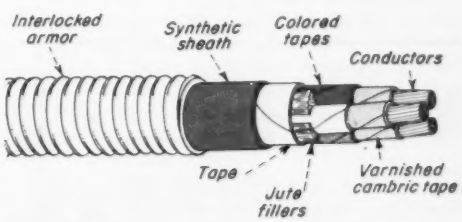
Popular types of wire and cable for today's plant needs . . .



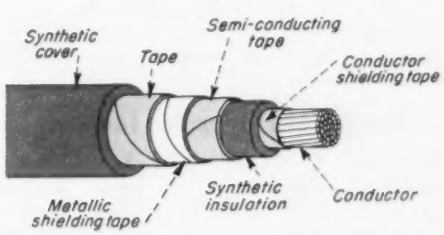
WIRE AND CABLE for circuits up to 600 v are used in conduit, metal molding, etc. Plastics are being used in place of rubber because they resist heat and moisture better and have a smaller diameter.



FLEXIBLE CABLE is used for portable machines, hoists, control stations. Fine strands of cables give flexibility, avoid kinking and snapping. Tough rubber or plastic protects wires from rough use.

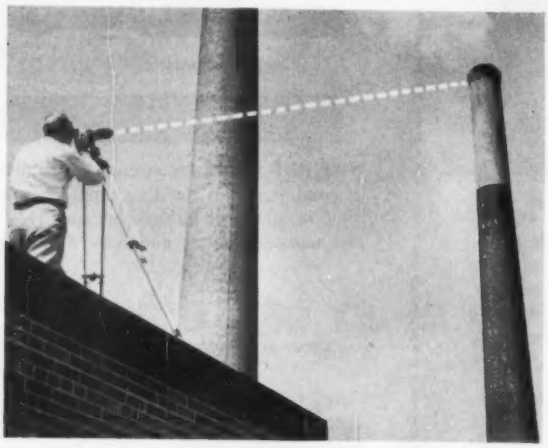


INTERLOCKED-ARMOR CABLE for high-voltage use is big brother of familiar BX cable. It's generally strung in wiring troughs. Steel, aluminum or bronze armor is now available to meet various conditions.



SHIELDED CABLE can be used in air, conduit or directly in the earth. It's made in several styles for high-voltage distribution. Plastic jacket compounds have high resistance to oils and chemicals.

Smart PRACTICAL IDEAS to help you speed up your



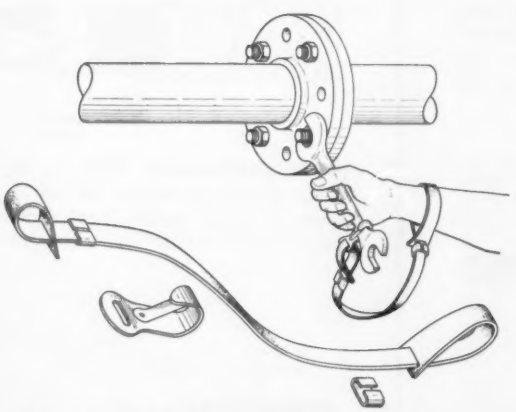
Looking for a stack of trouble?

You'll find plenty of defects in your brick chimneys at checkup time. But question is how to get up there for periodic inspections? Our stacks at Kodak Park are 366 ft high. I examine them twice a year with a 27-power telescope from a safe vantage point atop one of our buildings.

I look for loose mortar, cracks and possible damage to lightning-rod lines and supports. Checks are usually made in the spring and fall. Then every third year a steeple jack or chimney specialist makes a detailed inspection, both outside and inside the stacks. All needed repairs are made at that time.

These stacks have been landmarks in Rochester for half a century, and we want to keep them in top shape.

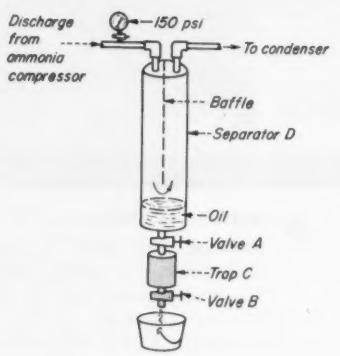
C O'NEIL *Rochester, N. Y.*



Use safety strap for tools when working overhead

How many times could you have avoided an accident, damage to machinery or loss of time, money or patience, if you had used this safety strap? Always use some type of safety strap for your hand tools when working overhead. Also use around machinery where accidental loss of a tool from slippery hands means trouble. Strap is quickly made from rawhide strip, metal snap clamps or nylon cord. Or you can use any light chain. Another good idea is to drill holes in tools, then attach to safety cord. But the main thing is to prevent accidents.

C H WILLEY *Penacook, N. H.*



You need an extra trap

In most refrigeration plants, oil is blown directly into atmosphere from the system. Trouble is that oil comes out as foam because 150-psi ammonia is acting on oil's surface.

To drain oil from system in less time, add trap *C* to separator *D*, sketch. To drain oil, open valve *A* just long enough to allow foam to drain into this chamber. Then close valve *A* and open valve *B*. Oil drains into bucket in a solid stream because it's under atmospheric pressure.

Our separator *D* is made from an 8-in. diameter pipe. But size depends on size of system. Our trap *C* is made of 4-in. diameter pipe. Another advantage of this extra trap is that no ammonia is lost to atmosphere. If bucket under trap is large enough, you can leave it while draining since valve *A* is closed.

E H BURK *Port Arthur, Ontario*

Paint shows loose nuts

A wrench is often used to check for loose nuts on important machine parts. But going over each nut with a wrench takes time. I solved problem by making visual checks, then using a wrench only once a year. Visual check is made by lining up the nuts with a colored paint, sketch. Then you can tell at a glance which nut has moved. You must make sure that each nut is properly torqued before spotting with paint.

N KHO-RAFANAN *Cebu City, P. I.*

operation and maintenance jobs

STEVE ELONKA, *Associate Editor*

What would you have done?

Our maintenance department built an unloading elevator. A 10-hp tower motor drove the head sprockets. Pit at elevator boot was for granular material dumped from freight cars. Unloading elevator worked nicely and management was well satisfied.

About a year later, plant load had increased to a point where powerhouse diesel-engine generators were loaded. Low-voltage troubles developed. Electricians overcame this by putting undervoltage protection on all unimportant motors so they'd automatically cut out and reduced the load. Unloading elevator was one of these.

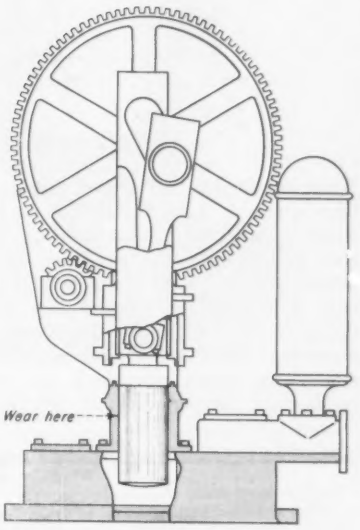
Everything worked swell until some unloading was done on a Saturday night when only one 40-hp diesel-engine generator was operating.

Elevator motor wouldn't start. When start button was pushed, magnetic contactor in tower snapped closed and motor started to revolve. But the heavy momentary starting current would overload the small generator and cause a voltage drop. Low-voltage relay would then drop out and shut down the motor. Trouble could be overcome by climbing to the elevator head motor in the tower and wedging the low-voltage relay closed. But electrician insisted that was an "idiot's delight" solution since no one would bother to pull the wedge out again. To run one of the big generators to maintain voltage during critical starting current rush was out of the question.

Electrician slept on the problem. Next day he wound a lower resistance coil for the undervoltage protection unit. He included an electric lamp in series for extra resistance to control current to undervoltage relay. This solved problem for cold resistance. While lamp heats very quickly, it does take time to do so. Low-resistance circuit at moment of closure permitted enough current flow to keep contacts closed while motor was speeding up and voltage dip was recovering.

Motor now could be switched across the line, as usual, without any kickout. Lamp was placed in a box near the pit. Then unloading crew could be sure that the elevator motor was running by just noticing if lamp was burning. That stopped the occasional plugging of the elevator boot around that plant. What would you have done?

G G PEARCE *Albuquerque, N. M.*



$15 repair saved us a $450 pump

Our small triplex plunger-type boiler-feed pump is over 15 years old and spare parts can't be bought. It's such a good pump that I prefer it over newer ones. Six years ago, plungers were worn badly, sketch, so we had to turn 1/16-in. off the diameter. Last year, plungers were again scored and worn badly. Since there wasn't enough left to machine off, I bought three 2½-in. diameter stainless-steel sleeves of 0.083-in. wall thickness.

For shrink fit, we turned plungers down about 0.002-in. larger than inside diameter of sleeves. Sleeves were then heated to a cherry red and shrunk over plungers. Next operation was to grind diameter down for a perfect fit and trueness. I'm sure we can keep this old pump working for many years to come by making these plunger repairs when they are needed.

When pump was new it had hard-rubber valves. Valves didn't wear very well against 240-F hot-water service. I made a set of valves from Micarta (thermo-setting plastic) pump stock. Now these valves last about five years.

There are various ways to build up worn shafts and plungers. But I've found that shrinking on a new sleeve of superior metal is usually less costly. It also does a better job. Then to remove, you can always split sleeve.

R BOETTINGER *Englewood, N. Y.*

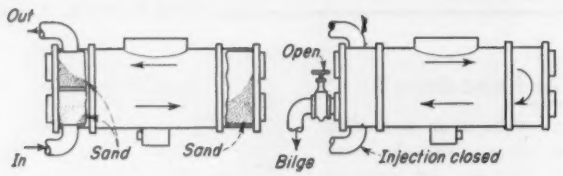
Turn page for more Practical Ideas ▶

Do you know . . .

how to lay up a boiler dry? How to lay it up wet? How to make an internal inspection? Do you know the three basic types of safety valves? These and many other examination questions are answered in *Plant Operators' Manual*, McGraw-Hill Book Co. Now, over 1500 illustrations show you everything clearly. This book is a collection of articles that appeared in POWER during the past nine years. They have been selected to answer the many questions that you boys write us about. They also help you prepare for license exams. References given tell you where to write for any added info you may need.

More PRACTICAL IDEAS

Begins on page 132

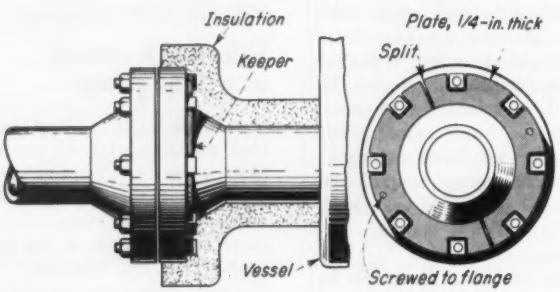


Here's your trick of the month

When our dredge first started digging the channel in Lake Maracaibo, sand would accumulate in corners of water ends of our main and auxiliary condensers, sketch. Sand would build up until it blocked and plugged 75% of the tubes. We had to shut down, open inspection plates and shovel out the sand. That wasn't very much fun at engine-room temperatures of 100 F.

One of our engineers suggested putting a 10-in. gate valve on a lower inspection plate. Then we could reverse flow by gravity. This trick worked so well that we have not had to open the condenser since. Now, to clean the condensers after each dredge load, we have only to reverse the flow for a minute or two, second illustration.

J A Bersen *SS Sand Captain*

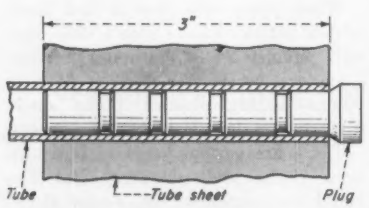


This keeper keeps you cool, saves maintenance $$

We often have to break a flanged connection at a hot-insulated vessel. Before, we had to remove the insulating blanket from the vessel flange to get to the rear stud nuts. Since installing the split keeper plate, sketch, we don't have to remove insulation. That's because this split keeper prevents the nuts from turning under the insulation.

Job is now done quicker and we don't have to allow vessel to cool since mechanic doesn't have to work in a confined area between flange and vessel. Keeper of this kind has many uses around plants. It's like another hand.

T R Hare *Berkeley, Calif.*

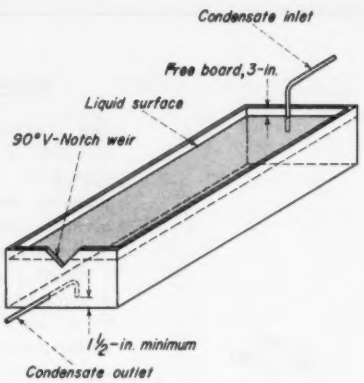


Need h-p tube plug?

We had to plug a leaky tube in our high-pressure closed heater. With 1200 psi and heater cut out of service and cooled every night, method of plugging gave us a problem. After discussing various methods, I decided on a solid steel plug, sketch.

Grooves on plug act as labyrinth seal. To assure a tight fit, plug was machined with a slight taper of 0.004-in. per in. of length. Small end was 0.001-in. under actual tube diameter. Leading edge of each section is chamfered to prevent gouging the tube. White lead was used generously to lubricate the plug while driving home.

O Hoksch *Lansing, Iowa*



Here's a better oil remover

In Power, Sept 1956, p 122, T Mullin tells how he removed oil from condensate in a hot well with newspapers. Editor suggests use of sponges in an observation tank as a better scheme.

Observation tank is widely used and has proved successful. But you have to remove the sponges when they become saturated and lose their ability to absorb oil. Then you have to empty the tank, which isn't always practical. If you have sufficient space, use a settling basin or a flume to separate the oil from the water.

My sketch shows details for such a separator. Condensate returns are piped to one end of unit. A 90-deg V-notch weir at the other end allows oil floating on water's surface to overflow into a disposal system. Bottom of condensate outlet pipe should be at least 1½-in. above separator's bottom. That prevents sediment, rust and other foreign matter that settles on bottom from being carried into the condensate stream.

Outlet pipe should be as low as possible to prevent turbulence near the liquid's surface. This gives you a better separating effect. Free board of 3-in. is recommended to care for liquid-level variations. To prevent fluid turbulence, have as great a surface area as space conditions permit. High ratio of length to width is best. Then you have reasonable time for oil-water separation.

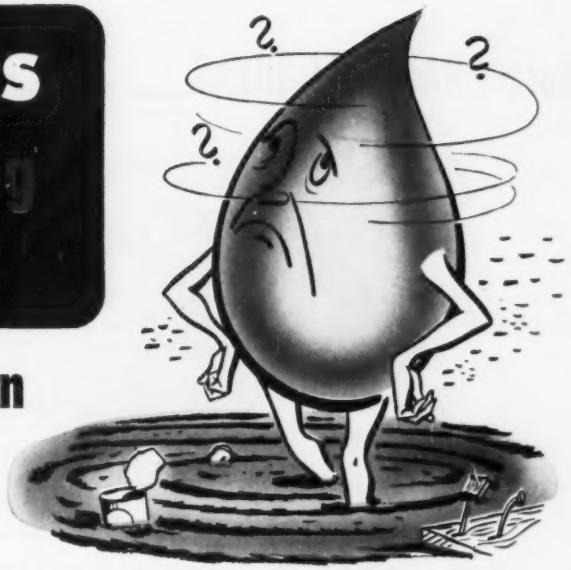
H B Wayne *Woodhaven, N. Y.*

Did you know...

that you must ventilate in pits or other low spots where flammable liquids might collect? Ventilation cuts down the danger of flash fires or explosions.

Turn page for more Practical Ideas ►

ALLIS-CHALMERS
Water Conditioning
ON THE JOB



Reporter finds solution to wide range of water problems

•Raw water is seldom suitable to meet specific requirements of the job. It usually needs some type of conditioning — best determined by a specialist. Here are typical examples of Allis-Chalmers water conditioning experience, equipment and chemicals in use.

Saved $22,000 First Year

Kansas—A chemical company plagued by high steam costs. Their boiler make-up water contained a high solids concentration, requiring a high blowdown rate.

After careful analysis of their problems, an Allis-Chalmers water conditioning engineer recommended Allis-Chalmers Anti-Foam. Use of this chemical resulted in increasing the solids concentration of the boiler water without carry-over. This, in turn, reduced the percentage of blowdown required.

Using A-C Anti-Foam, the company conservatively estimated first year savings of $22,000 in heat, water and chemicals.

* * *

Replacement of Condensate Return Lines Reduced to Practically Zero

Wisconsin—Here in one of the largest malt producing mills, several million pounds of steam are used daily for drying malt.

A special crew used to work all day every day doing nothing but replacing corroded condensate return lines. This, of course, was extremely costly.

Seven years ago, Allis-Chalmers water conditioning engineers were called in. Use of Allis-Chalmers No. 160 return line corrosion inhibitor was suggested.

Piping failures were reduced to the point where they only occur occasionally, and the maintenance crew has been assigned to other duties.

The Customer Is Always Right . . . Well, Most of the Time

East Coast — This plant had been using internal treatment of its boiler water. Chemical costs seemed excessive to management. After analyzing their own situation, they requested bids on a deionizer for treating makeup.

Instead of merely submitting a bid on the equipment specified, Allis-Chalmers engineers analyzed the water and the plant problem. This analysis showed that plant needs were such that a deionizer wasn't needed.

All that was needed was a de-alkalizer. Result: a savings of thousands of dollars.

* * *

The Case of the Dirty Dishes . . . or Don't Blame the Poor Dishwasher

Midwest — A harried plant cafeteria manager placed a frantic call to Allis-Chalmers water conditioning experts. Something was wrong. Glasses were spotty and plates had to be individually wiped off before they could be used. The grumbles were growing in the dining room . . . costs rising in the kitchen. His brand new $30,000 dishwasher wasn't getting the dishes clean, and the supplier of the dishwashing machine said the trouble was caused by the water.

The only trouble with that theory was that he had just installed a water softener the year before. The Allis-Chalmers water conditioning engineer examined the dishes coming out of the water and then asked to see the water softener. The problem was obviously hard water. The unit seemed to be in good working order and the tag indicated the softener had been recharged the previous day.

The maintenance man was called and asked to recharge the softener while an A-C engineer stood by. He went through all the steps—all but one, that is. He failed to close the bypass valve above the softener and practically none of the water went through the softener. It was then learned the operator was new and had not been properly trained.

Needless to say, the maintenance man is now an expert at operating the system, and everyone is pleased with the sparkling dishes.

Moral: A-C engineer's service covers the water front.

Expert Saves Steam for Drop Forge User

North Central — An Allis-Chalmers water conditioning engineer was called in by a manufacturer to supply water conditioning for makeup water. In checking the plant, here's what he found:

A large number of steam-operated drop forges are used by this company. The steam picked up oil from the pistons of the forge and was too contaminated for further use. It was dumped to waste.

He recommended installation of condensate oil removal filters. This was done and today practically all condensate is recovered. Makeup and water conditioning requirements are greatly reduced.

Problems Solved

For an answer to your industrial water problem, call the A-C office nearest you or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

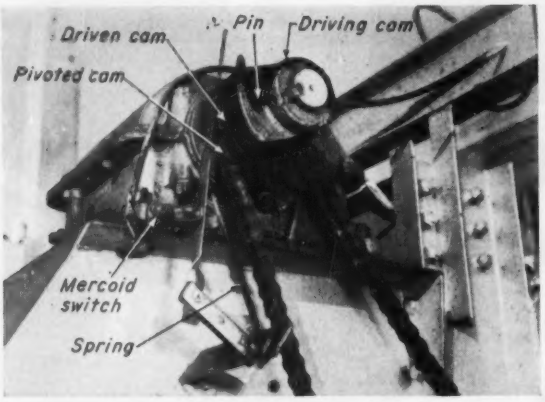
A-C ALLIS-CHALMERS

A-5237

WATER CONDITIONING • CHEMICALS, EQUIPMENT, SERVICE • FOR OVER 25 YEARS

More PRACTICAL IDEAS

Begins on page 132



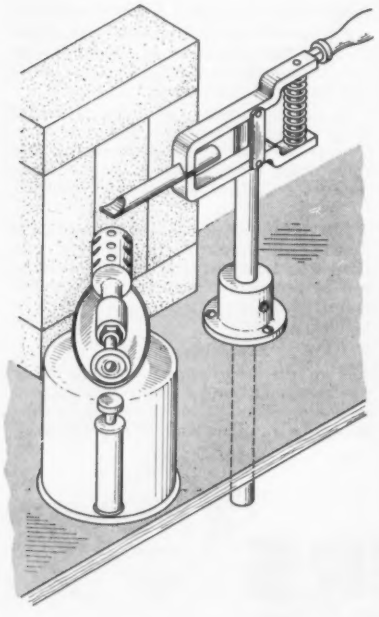
Now, this alarm tells operator if screen stops

Traveling screen at the intake of our raw-water pumping station was driven through a shear pin. But pin often broke when the screen was jammed by ice, or by sticks that got through the trash racks. Operator, busy inside plant, wouldn't always know that the screen had stopped until the low-water alarm bell sounded in the pump's suction pit. To warn of stoppage, we installed device shown in the photo.

We mounted a mercoid switch on the pivoted arm. Arm is held by a spring against face of the driven cam on the screen driving shaft. Source of 110-v power is connected through the switch to a lamp at the operator's desk in the station. Each revolution of the semi-elliptical-shaped cam caused the arm to oscillate, tilting the mercoid switch back and forth. That makes and breaks the electrical circuit, causing lamp to flash on and off.

Previously, when pin sheared, driving cam kept rotating. But cam stopped, leaving the arm stationary and the switch in either on or off position. This caused the lamp to burn continuously, or not at all, instead of flashing. Flashing now attracts attention of operator, who can go out and replace the shear-pin before the screen becomes clogged. This hookup has proved very reliable.

N PITTINGER *Asheville, N. C.*



Need a third hand?

Do you like to make handy labor-saving gadgets? If so, sketch shows a good bench clamp that holds work while welding, brazing, tempering, etc. It's easy to operate, can be raised and lowered or swung around. The gadget is one of the handiest tools I've ever used.

You don't have to make it as fancy as the one in my sketch. The main feature is to have it made so the spring pushes the jaws down on any light object you want held. You can make it as large or small as needed. Feature of adjusting height by tightening collar in right spot on shaft is also priceless. And of course the fact that you can turn this clamp in any direction is a big help. Because mine is usually used in connection with heat of some kind, I have firebricks built in back as shown. This saves time of putting up asbestos or firebrick each time clamp is used. Every repair shop needs one.

C H WILLEY *Penacook, N. H.*

Here's to *safe* grinding

In POWER, Sept 1956, p 121, R J Anderson says that plastic shield is superior to goggles for grinding-wheel use. Here's a snapshot of our grinding wheels, protected with sheets of lucite. Shields are hinged at top to permit swinging up and down. Or we can adjust them to any angle to suit our work. Point is, they are always there and are used because they don't have to be pulled over the head as do goggles.

J W BLAKE *New York, N. Y.*

I don't agree, use safety glasses

One POWER reader places a swivel sign over a grinder switch, instructing users to wear goggles. Another uses plastic shield. These are good, but neither of them works all the time, which is the intent of safety devices.

We tried both those two ideas in our plants. First we placed goggles over the switch so the user had to pick them up in his hand before he could reach the starting button. But they still forgot at times.

Eye protection that works 100% of time is to provide workers with safety glasses, prescription ground, if necessary. These are worn at all times while on company property. Our safety department has a perfect record in eye injuries since use of safety glasses were enforced. They're your best bet.

S KRONE *Canby, Minn.*

My biggest boner

Please turn to page 194

boiler water levels now easier to **see**... easier to **read**

Whatever the boiler pressure, high or low, YARWAY Remote Indicators give accurate, instant, eye level boiler water level readings at any convenient plant location.

Boiler Code Case No. 1155* says in part, "... two independent remote level indicators of the compensated manometric type may be used instead of one of two required gage glasses for boiler drum water level indication in the case of power boilers with all drum safety valves set at or above 900 psi..."

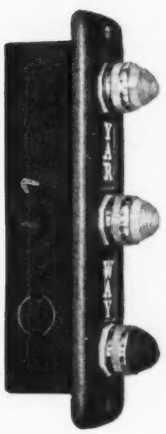
YARWAY Remote Liquid Level Indicators fill the bill—and feature a "wide vision" face that makes reading easier from any angle.

Accurate—because indicator is actuated by the boiler water itself—by the pressure differential between a constant head and the varying head of water in the boiler drum.

Also use YARWAY Remote Indicators on heaters of various types.

For full description, write for YARWAY Bulletin WG-1824.

*Write for free reprint of case description.



Yarway Remote Hi-Lo Alarm Signals—lights or horns—can be used with Yarway Remote Liquid Level Indicator and placed at any location in the plant.

YARNALL-WARING COMPANY

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YARWAY REMOTE LIQUID LEVEL INDICATORS

Have a PLANT PROBLEM? *Tap the*

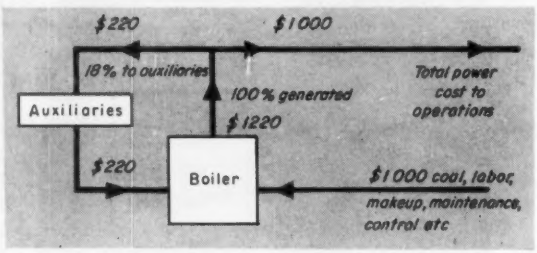
The problem

What's the best way to figure steam savings?

Our plant includes a medium-size boiler that supplies process and heating steam. In our monthly report we make a distinction between steam generated in the boiler and steam distributed to the plant. Steam distributed amounts to about 82% of the steam generated—the difference being used for boiler-room auxiliaries.

By making improvements we expect to save a certain amount of steam and we want to use a logical basis for computing this savings. Savings will be expressed in dollars per 1000 pounds of steam. We'd like to know whether it should be calculated on the basis of steam generated or steam distributed. This is important because the figure would be different for each method of calculation. And since the savings justify the investment, figuring it one way or another might mean the difference between approval and rejection.—*AWP, October Power*

The solutions



Basic problem is defining unit costs

If figured correctly, unit costs for steam generated and steam distributed should be the same, sketch above.

Steam to auxiliaries becomes a part of the calculated cost of generating steam. Thus the unit costs are the same. The dollar figures, sketch, can be interchanged with steam quantities. *Example*: For 1220 lb steam per hr generated, 1000 lb per hr will be distributed to operations and 220 lb per hr will go to the auxiliaries.

I wouldn't calculate savings on a total unit cost. Unless a reduction in manpower requirements results, or unless high makeup is a problem, justification of charges for cost reduction would probably be based on fuel savings alone. This can easily be picked out of unit cost.

B L Pope, *Chattanooga, Tenn.*

Don't use cost per 1000-lb steam, figure on basis of total steam

Assuming that *AWP* generates ten million pounds of steam in a month at a cost of $10,000, his generated steam cost is:

$10,000 ÷ 10,000,000 = $1 per 1000 lb steam.

If he reduces his steam consumption by 10%, he would have to reduce his operating costs 10% before he showed any savings on a per-1000-lb basis:

$9000 ÷ 9,000,000 = $1 per 1000 lb steam.

He has reduced his operating expenses by $1000 per month. Yet, using his proposed method, he has actually shown no savings.

AWP should talk in terms of reduction of pounds of steam generated and reduction in dollars of operating costs. Savings should then be figured on the basis of total steam generated and not on steam distributed.

L P Zicari, *Rochester, N. Y.*

Generated cost is best index

AWP should use the generated cost of steam to figure savings. Fuel, largest item on the cost sheet, must be bought for total steam generated. This is true for other items too.

C D Morgan, *Elkland, Pa.*

know-how of over 45,000 Power readers

HOWARD KALLEN, *Associate Editor*

Use initial efficiency as base

When figuring savings, use the initial efficiency as the base, in this case 82%. If savings noted increase this figure to 87%, percentage of saving is:

$$(87\% - 82\%)/82\% = 6.1\%$$

If the present steam cost is one dollar per 1000 lb, the new cost will be $0.939 per 1000 lb. From this figure *AWP* can easily calculate total savings in dollars.

He can use the same procedure in finding out savings due to changes in fuel or in steam-generating efficiency. Take the initial cost as 100%. New cost is the ratio of the old cost to the new steam-generating efficiency.

H G MEISSNER, *P.E., Mt. Vernon, N. Y.*

Show both gross and net generation

Best way to present boiler-plant costs is to show both gross and net generation. Difference is the quantity of products used in the boiler room to generate the steam. Cost may be expressed in dollars per 1000 lb steam or dollars per million Btu.

Any gain in operating efficiency will narrow the difference between the gross and the net figures.

B M KECK, *Austin, Minn.*

Here's how I'd do it

Figuring savings based on cost per 1000 lb steam isn't right, regardless of whether it's steam generated or steam distributed. Either method can produce wrong conclusions.

If improvements were made to some steam process, using equipment that would reduce steam consumption 50%, there would be a fuel saving. But, because of the fixed cost in generating steam—labor, maintenance and auxiliaries—the reduced steam generation would probably result in higher cost per 1000 lb steam.

In contrast, allowing large steam leaks in the distribution system and steam using equipment, would probably result in a reduced cost per 1000 lb steam because fixed costs—labor, maintenance, auxiliaries—would be distributed over a large quantity of steam.

Savings should be figured directly in dollars, taking into account cost of fuel saved, savings in auxiliary steam, electricity and labor. The cost should then be weighed against the amount saved.

A more useful guide than cost per 1000 lb steam, would be an analysis of total boiler-plant labor costs, total annual fuel costs, total steam generated, boiler efficiencies during business and nonbusiness hours, net boiler efficiency and measurement of steam used by auxiliaries in different parts of the plant. Such data would permit an accurate analysis of operation and would show up the areas where the most practical and major savings could be made.

S S GUZZARDI, *Consulting Engineer, Philadelphia, Pa.*

Only variable is actual fuel cost

When figuring savings due to plant improvements, *AWP* should be fully realistic about them. In an industrial boiler plant, charges for labor, power, maintenance, supplies and such fixed charges as depreciation, change only slightly with changes in boiler load. Since these costs are relatively fixed and account for more than half of the cost of steam generation, the only real variable is fuel cost.

Although the cost per 1000 lb steam distributed is OK for accounting purposes, savings claimed would be difficult to prove later. In using fuel cost only, a longer period will be needed to pay for the improvements.

F M LEADER, *Bristol, Pa.*

Cost varies from plant to plant

Cost of steam produced per 1000 lb differs from plant to plant, depending on a variety of factors. Size of plant, age of equipment, efficiency of operating force, automatic controls, auxiliaries, metering equipment, labor, fuel costs, all affect final cost per 1000 lb steam.

We use two steam flowmeters. One for steam delivered to the plant and one for steam used in the boiler plant. All steam generated by the boilers is recorded by these meters.

Evaporation of water used per lb of coal is shown on our cost sheet. *AWP* should deduct water losses due to main blowdown and continuous blowdown, from total water used per month.

Our steam cost runs from $0.75 to $0.80 per 1000 lb steam.

A BELTON, *Montreal, Canada*

Use incremental costs

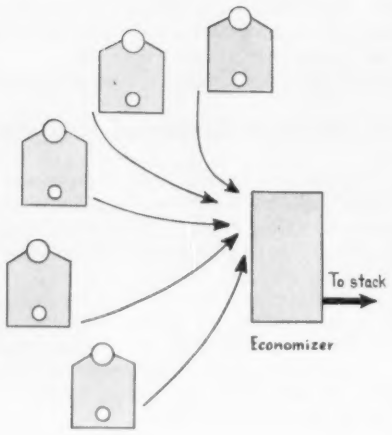
Since operating expense is related to fuel burned, I recommend costs be figured on the basis of total steam generated, regardless of steam's ultimate use. Any improvement leading to steam savings influences fuel consumption. If these changes reduce steam use in the plant, in the boiler room, or in both locations, the end result influences fuel cost—a direct operating expense.

AWP should use the incremental cost method to estimate savings. Lowest unit steam cost (dollars per 1000 lb steam) doesn't necessarily mean that *AWP* is getting top savings from his proposed improvements. True cost is the sum of fixed charges and operating expense. Fixed charges depend on capital investment, period of amortization and interest rate. Operating expense consists of fuel, labor and maintenance, throughout the operating period.

H B WAYNE, *Woodhaven, N. Y.*

Turn page for info on using economizers ▶

More PLANT PROBLEMS Begins on page 138



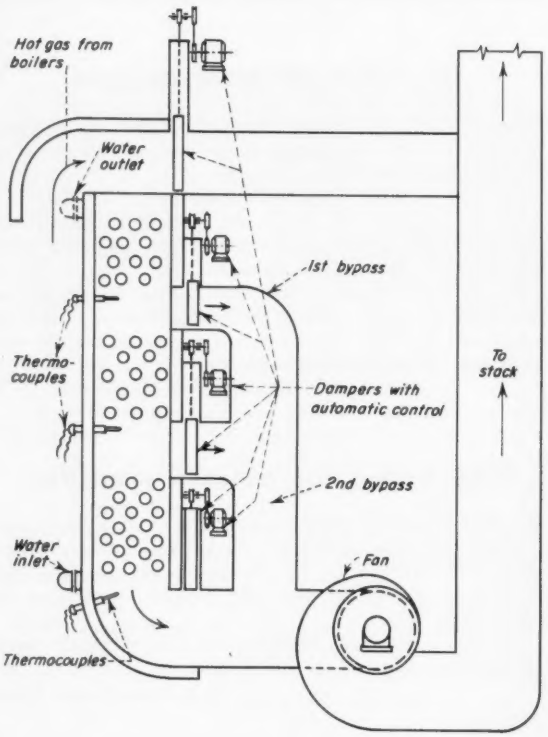
The problem

Can we use one economizer with five boilers?

Some time ago we installed two 70,000-lb-per-hr 600-psig boilers set for spreader-stoker firing. We ran them along with five old 115-psig units. 600-psig steam was used to drive a turbine-generator that exhausted into the 115-psig line. A parallel reducing valve balanced the load.

Now we are about to replace the five old boilers with five 40,000-lb-per-hr 600-psig units. Available space is limited. If we could use one economizer to serve all five boilers, space could be cut down substantially. Also, we want to keep flue-gas temperature above the dew point.—*EEC, October Power*

The solutions



Here's how *EEC* can use one economizer in multi-boiler plant

EEC can install one economizer for the five boilers by providing one or more gas bypasses to keep flue-gas temperature above the dew point, in case one or more of the boilers are shutdown.

For best performance, thermocouples should be installed and located at end of the economizer and before each bypass. These can transmit temperature signals to the control room and also operate power dampers, sketch above.

J Boresta, *West Englewood, N. J.*

Five old boilers should be replaced with three larger units

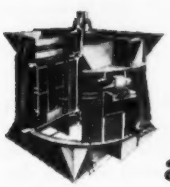
Assuming *EEC's* two 70,000-lb-per-hr units are modern and in good condition, or could be economically modernized, here's what I'd recommend:

Replace the five old 40,000-lb-per-hr boilers with three new 70,000-lb-per-hr, 600-psig units of the same make and kind as the two you installed sometime ago. This arrangement will give you 10,000 lb per hr more capacity than you now have. And a total of five 70,000-lb-per-hr boilers of the same make would mean a much smaller inventory of

(*Continued on page* 142)

Advantages of the Ljungstrom Air Preheater

- Size for size, recovers more heat than any other type.
- Eliminates cold spots . . . keeps corrosion to minimum.
- Easier, faster to clean and maintain.
- Requires far less supporting steel and is quickly erected.



7 out of 10. . . air preheater installations are Ljungstrom®

MAXIMUM HEAT RECOVERY is one important reason. As a general rule, a height of one inch of the heating surface used in a Ljungstrom Air Preheater will recover about as much heat as one foot of length of the standard surface of conventional type air preheaters. For the interesting full story, send for a free copy of our 38-page manual.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

spare parts. Also, a like pattern of operation would be suitable for all units.

Three 70,000-lb-per-hr boilers would not require as much space as would five 40,000-lb-per-hr units. The 70,000-lb-per-hr boilers could carry full load on any four units with 125% load. You could then do work on any one boiler that may need repair or maintenance.

Another possibility: Two 100,000-lb-per-hr units. The two existing 70,000-lb-per-hr boilers could eventually be replaced with one more identical 100,000-lb-per-hr unit. Carrying 350,000 lb per hr with the three units would represent operation at 115% load.

Most steam generators can be operated at 200% load for several hours if necessary. Caution to *EEC*: Don't attempt running the plant at greater than 100% load without water conditioning and close control of all operaions.

C G Howarter, *Canton, Ill.*

EEC can use one economizer but he'll sacrifice flexible operation

One economizer may be used if it has sufficient absorbing area to lower the flue gas temperature to the desired level.

EEC is concerned about space. What about height? Most modern plants have economizers higher than boilers. If he installs only one economizer he'll be forced to use bypass flues for boilers. These would be needed when economizer is down for repair or routine maintenance.

The problem really boils down to flexibility of operation. For instance, *EEC* could use one boiler if it were large enough. But he wants a multi-boiler installation to give him flexibility.

Expected load is 340,000 lb per hr. Assuming 4 Btu per sq ft of economizer heating surface and a 200-F temperature difference between gas and feedwater;

$$4 \text{ Btu per sq ft} \times 200 \text{ F} = 800 \text{ Btu per sq ft, total}$$

Required heating area, using one economizer and assuming a 10 F increase, is:

$$340{,}000 \text{ lb per hr} \times 10 \text{ F}/800 = 4250 \text{ sq ft.}$$

Thus, space required for economizer heating surface would be proportional to the feedwater temperature increase *EEC* expects to get. He should check plant heat balance.

L Harrop, *Toronto, Canada*

One economizer can be used but don't forget economics

Engineering-wise there's no reason why *EEC* can't use one economizer. But I doubt if it would be the most economical solution to his problem.

Cost of special design and automatic control features needed might well wipe out any savings *EEC* expects to make. A better approach, I believe, would be to conserve space by going to a smaller number of boilers. He could do the job with two large boilers, each fitted with their own economizers. Besides, high reliability of today's boilers makes it unnecessary to go to five small units. Control would be simpler too. If I were *EEC*, I'd reconsider any plans his company may have to buy five boilers.

J Sparks, *Seattle, Wash.*

Want help with your plant problems? Send your design and operating headaches to us. We'll give *Power* readers a whack at them.

Your January Problems

1 Why doesn't surface condenser maintain high vacuum?

I'm chief engineer of a municipal power plant that generates electrical power from two 5000-kw condensing turbine-generators. Both of these units have been in service almost ten years. And, until recently, we haven't had a bit of trouble with either one of them.

We normally expect the condensers to pull between 28 and 29-in. Hg vacuum. Both units are equipped with steam-jet air ejectors. Cooling water is from a river along which the powerhouse is built.

About a month ago we noticed that one of the condensers could do no better than 27-in. Hg vacuum. And the condition appears to be getting worse. Naturally, this cuts down on machine output—a situation we can ill afford.

Have *Power* readers had similar experiences? How have they solved the problem?—*KDG*

2 What are pros and cons of a protective refractory wall?

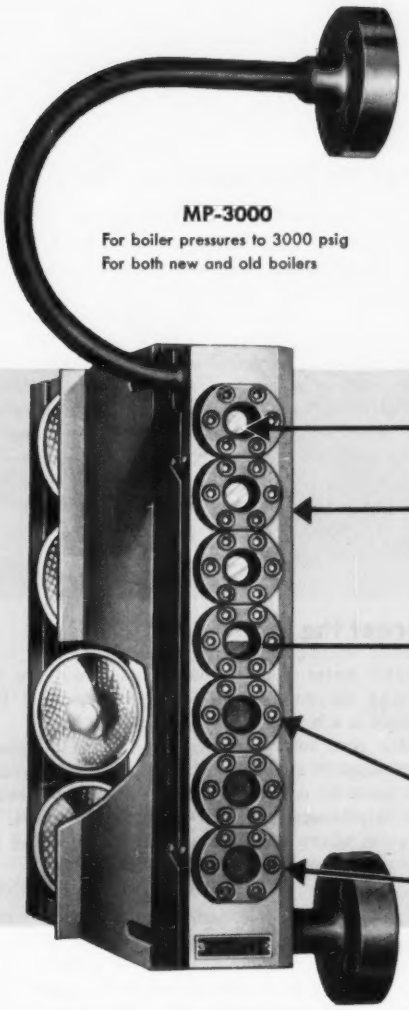
I would like to know the advantages and disadvantages of a protective refractory wall on the fireside of the water wall. The protective wall would be just high enough to stop the carbon soot emission caused by temperature difference when flame strikes the water wall.

We operate under a strict smoke emission law in our city. Thus, we must use excess air to eliminate smoke. If we could do the same job by using the fire protected wall, I believe we could reduce the excess air, raise the CO_2 and get better efficiency. Would this soot cause slagging in the superheater tubes? I would appreciate opinions of *Power* readers since we're considering a protective wall.—*EEC*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches.

MORE THAN 950 DIAMOND MULTI-PORT GAUGES

In use and on order for over 240 Central Station Generating Plants



MP-3000
For boiler pressures to 3000 psig
For both new and old boilers

SMALL ROUND PORTS INSTEAD OF LONG GLASS AND MICA STRIPS

GAUGE NEVER REMOVED FROM BOILER FOR GASKET CHANGES OR OTHER NORMAL MAINTENANCE

STEAM SHOWS RED
WATER SHOWS GREEN

COMPLETE PORT CHANGE REQUIRES ONLY ABOUT 15 MINUTES

EACH PORT THERMALLY INDEPENDENT

Because the Diamond Multi-Port solves the problems inherent in water level gauges on boilers operating at high temperatures and pressures, it has had rapid and wide acceptance. In addition to the 950 for central station generating plants, more than 100 have been sold to industrial power plants.

Advantages of the Multi-Port are many. In addition to those shown above, it has maximum thermal stability for rapid starting . . . "Hi-Lite" illuminator for improved readability . . . welded construction for permanent tightness . . . end stems can be furnished instead of flanges . . . startling reductions in maintenance costs.

Write for Bulletin 1174U for more information.

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ARGUMENTS . . . *let other readers know your views*

ALTHEA THORNTON, *Assistant Editor*

We all agree: at least two men per boiler room

Brings back memories

Van Huben's article in October *Arguments* brings back memories of a certain night nine years ago.

I was a shift operator in a 200-hp boiler room. I was alone. The plant provided processing and heating requirements. There were two 100-hp firetube boilers with stokers, and one vertical double-acting feed pump, manually controlled.

On this particular night, I was seized with a sudden attack of pleurisy. Although the stoker switch was only about 8 ft away, my attack was so severe that I could not reach it. Breathing was agony. Unable to move, I waited 50 minutes until the watchman came to the boiler room on his rounds.

During that time, there was a greater demand for steam; the hoppers went short of coal, fire burned back in the retort and gas and smoke blew out through the hopper. Water level fell steadily.

When the watchman found me he summoned the night supervisor. I told him what I could about the boilers. He probably saved the plant from shutdown caused by low water, a fusible plug or a tube burning out.

This is just my case. As Van Huben says, it's good insurance to have two men on every shift. I firmly believe him; but does management?

S J DUPUIS, *Halifax, N. S.*

One man operation is risky

I have seen 100-lb plants that would be suicide to operate with only one man; yet, some 900-lb plants seem to lend themselves to one-man operation.

Here are some things to consider: (1) What is the fireman's age? (2) How is his health? (3) Does anyone come to the boiler room periodically, such as guards, supervisors, etc? (4) Do the guards or supervisors have a basic knowledge of the plant? (5) Are they allowed to act if they find the fireman injured or dead? (6) What safety devices do the boilers have? (7) How often are they tested? (8) By whom? (9) Is water-softening equipment in service at all times? (10) Type of softening unit? (11) Type and pressure of boilers, especially if softening is continuous, with high makeup? (12) Is continuous operation vital to production? Would a 15 to 20 min. shutdown caused by operation of some automatic safety device be critical? (13) What is the plant's physical layout? (14) How does the insurance company feel about one-man operation? (15) What equipment other than boilers and their auxiliaries is the fireman responsible for?

One man operation of a boiler plant is risky business; in my opinion, it should be avoided.

C L MCMILLIN, *Hutchinson, Kan.*

Watch out for the calculated risk

Frequent arguing with economy-minded administrators brings out this contention: one-man boiler-room operation is a calculated risk, necessary to keep operating costs as low as possible.

They fail to recognize this risk as foolhardy and sometimes costly, especially when production is lost and expensive equipment is subject to damage.

The problem stems from failure to recognize that boiler-plant expenses are relative to the production of steam or power, as the expenses of operating production machines are to the final product.

The modern trend discards the old idea that boiler plants are necessary expenses with no returns. With this new importance, boiler plants should be adequately staffed and modernized.

ERNEST SIDEWITZ, *Brooklyn, N. Y.*

Don't forget the laws

In many states and municipalities there are laws governing the number and class of personnel to be employed in a boiler room.

Boiler size, total installed capacity and pressure dictate number and type of personnel. The requirements must be considered when estimating personnel needs, labor costs and other operating expenses.

In areas where the rules are not in effect, at least two persons should be on duty at all times.

H B WAYNE, *Woodhaven, N. Y.*

We prepare for emergency

In our plant we have an operator, an assistant operator and a shift foreman in charge of the boiler plant and powerhouse. So we are prepared for the possibility of more than one thing going wrong at a time.

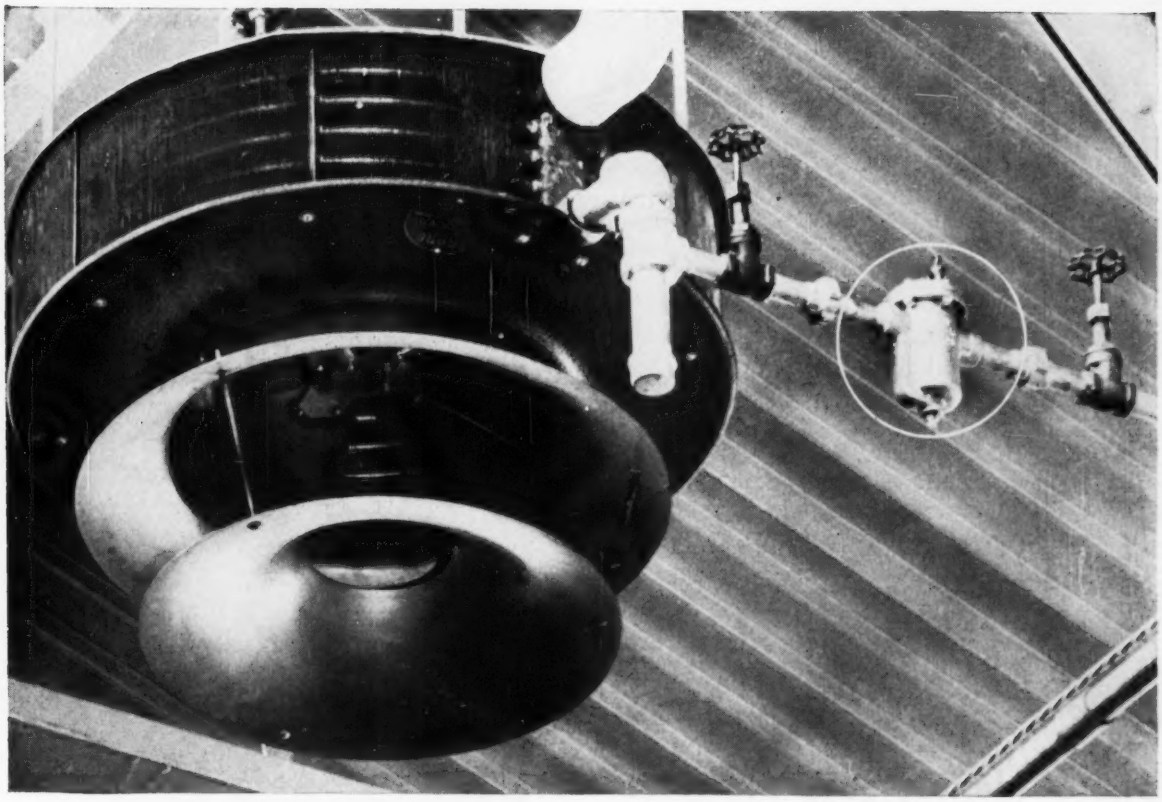
E PEACOCK, *Noranda, Que.*

What about vibration effects?

Your article, "Telescope-mirror alignment method," POWER, Dec 1956, p 117, is excellent. Schultz is to be congratulated on working out a method of aligning machines while they are running. Now bearings can be aligned to favor those thrown out of line when machine is hot.

But, I think vibration is going to affect the results. Telescope rests on the floor plates where there is vibration. This will affect accuracy. What do other readers think about this?

G A ROSTOFF, *Philadelphia, Pa.*



Here's the Way to Trap a Unit Heater for Lots of Heat and Little Maintenance

The picture above is an outstanding guide to good unit heater trapping. This installation provides maximum heater efficiency and minimum maintenance time and cost.

1. Simplified piping. Horizontal in-line piping is made possible by the Armstrong side inlet—side outlet trap body. Note that the trap can be opened by removing the cap, without disturbing pipe connections.

2. Dirt pocket ahead of trap. The vertical pipe leg collects heavy dirt and scale. No strainer is needed because the self-scrubbing action of an Armstrong trap washes ordinary dirt right through it.

3. Test valve. The maintenance engineer can check this trap quickly and easily by opening the test cock shown installed in the trap cap.

4. Shut-off valves and unions. The trap can be repaired, or replaced with a spare trap, without shutting off any other units.

5. Generous sized trap. The Armstrong trap, selected from Table B-29 or C-29 in The Armstrong Steam Trap Book, provides a minimum safety factor of 3 to 1 for this job. Its big air handling capacity keeps the heater free of corrosion-producing air and CO_2, provides fast heat-up and full rated btu output. No lag—condensate is discharged at steam temperature.

6. A good steam trap. The Armstrong trap discharges condensate at steam temperature and it has large air venting capacity. The heater is always full of hot, dry steam.

The Armstrong trap mechanism cannot clog, bind, stick or collapse. Valve and seat are hardened chrome steel—all other working parts are stainless.

An Armstrong trap is rated conservatively on a basis of actual hot condensate capacity under job operating conditions. This is not true of all traps and is an important factor when comparing prices.

Armstrong traps are sold by factory-trained Representatives under an unconditional, money-back guarantee of satisfaction to the user.

For the best in unit heater trapping, call your local Armstrong Representative, or write:

ARMSTRONG MACHINE WORKS
8121 Maple Street • Three Rivers, Michigan

FREE—"How to Trap Unit Heaters" is the title of pages 28 and 29 in The Armstrong Steam Trap Book. This 44-page catalog is a guide to good trapping practice. Send for your copy.

STEAM TRAPS FOR EVERY REQUIREMENT — APPLICATION ENGINEERED

ARMSTRONG STEAM TRAPS

TRAILER is parked near waste outlet line from plant where 24-hr test of pH and flow rate is conducted

PANELBOARD has low- and high-range flow recorders; pH indicator sends signal to recorder

HOW TO

check plant-waste effluents

► TRAILER, above, is equipped to make 24-hr tests of a plant's effluents through continuous measurement of pH (acidity or alkalinity), flow rate and total flow volume. The trailer, used to rove from plant to plant by Charlotte, N. C. Water Dept, contains the first, compact, automatic pH recorder, according to the manufacturer.

City regulations require each plant discharging over 40,000 gpd to have its effluent checked every 90 days. Further, any corrosive mixture detected at disposal plants must be traced to their source and the plant responsible for it is notified. This testing is done for over 60 plants. There are 500 miles of sewer lines spread over a 45-sq-mile area.

Excessive acidity or alkalinity corrodes sewer mains badly, is dangerous to fish and bathers. And it can spoil sludge from treated sewage which is sold for soil enrichment.

Once instrument is connected to effluent line, recorder's pen plots pH value of waste on a paper chart. At same time, one of two flowmeters chart flow rate—one meter is used for low, other for high flow rates. An integrating device on each flowmeter shows total flow volume for test period.

Time markings on charts tie in recorded values with exact time of day. Charlotte's engineers can see if plant's effluent remains within permissible limits during 24-hr test period. Regulations require pH to remain within range of 6 to 9, 7 being a neutral value.

Sample is also taken for laboratory analysis. This becomes routine or a matter of high priority, depending on story pH recorder tells. Plants discharging over 40,000 gpd of waste must install holding tanks from which waste can be released at acceptable rates into city's mains. If waste is highly acid or alkaline, waste must be treated to prevent trouble.

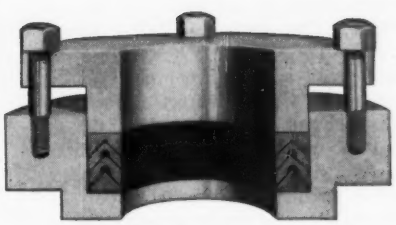
—Courtesy, Leeds and Northrup Co, Philadelphia, Pa.

ELECTRODE assemby has temperature compensator, extension cable for inserting into effluent line

CHART RECORD shows variation in pH throughout 24-hr test. Mobile unit may solve your problem

ONE OF THE GARLOCK 2,000

Why Garlock CHEVRON* Packing is really Automatic



This design is entirely different from ordinary V-type packings. CHEVRON has an exclusive hinge-like construction, assuring the automatic action for which it is designed. This also permits the use of less packing in shallower stuffing boxes.

The unique construction of Garlock CHEVRON permits free operation of rods or plungers at all pressures. As pressures increase the packing automatically tightens to prevent leakages. As pressures decline the CHEVRON Rings instantly ease off permitting free operation without leakage.

Therefore, after you make initial adjustment of the gland, no further adjustments are needed to compensate for variations in pressures.

Exclusive CHEVRON is one more part of "the famous Garlock 2,000" . . . two thousand different styles of packings, gaskets, and seals for every need—the only complete line. That is why you get *unbiased* recommendations from your Garlock representative. Call him today or write for CHEVRON Folder AD-115.

*Registered trade-mark

THE GARLOCK PACKING COMPANY, Palmyra, N. Y.

For Prompt Service, contact one of our 30 sales offices and warehouses throughout the U.S. and Canada.

GARLOCK

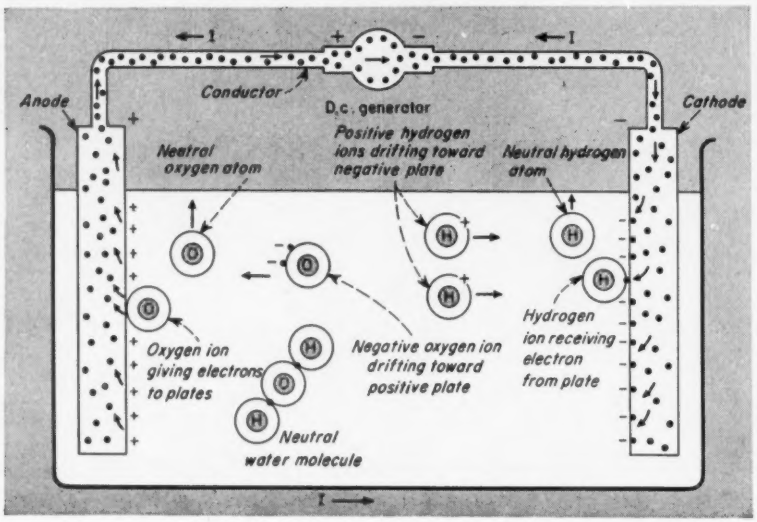
Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints

BASICS . . . bringing engineering theory down to earth

NORMAN PEACH, Assistant Editor

Electricity: 6

Electrolytic circuits



► SOME LIQUIDS conduct electricity, others are good insulators. Perfectly pure water is nonconducting, but if a small amount of certain impurities, notably soluble salts, acids and alkalies, are present, water becomes a conductor. Liquid circuits through which electricity flows are called *electrolytic circuits*. Current flows in electrolytic circuits in a different manner than in solid conductors. To understand how current flows in these circuits we've got to go back and take another look at the atoms and electrons which make up substances. (See *Basics* No. 1, Aug 1956, p 148.)

Pure water is composed of neutral molecules which show no electric charge. Each water molecule has two hydrogen atoms bound to one oxygen atom, as represented by intersecting circle of electron orbits in sketch above. A little sulfuric acid in the water, for example, causes some of the water molecules to break up into oxygen and hydrogen *ions*. Ions are not the same as atoms; although they are dissociated from each other they remain, in some respects, part of a water molecule. That's beginning to get rather deep into the electron theory; the important thing is that ions, unlike atoms, have electric charges. Hydrogen ions are missing one electron and therefore have a positive charge. This is represented in the sketch by a gap in the electron orbit. Oxygen ions, on the other hand, have two extra electrons that they have picked up from the two hydrogen atoms which were in the water molecule. This gives the oxygen ion a negative charge, indicated in the sketch by two extra electrons stuck to the outer electron orbit. For the sake of simplicity, the inner electron orbit is not drawn and normal electrons in the orbit are not shown.

The dc generator creates an emf that causes electrons to move from positive plate to negative plate through the conductor. Shortage of electrons on the positive plate gives it a positive charge that attracts the negative oxygen ions. When they reach the positive plate they give up their extra electrons and become neutral oxygen atoms. Since oxygen is a light gas, these atoms rise to the surface and escape into the air. Electrons are thus supplied to the positive plate to keep up the flow of electrons. At the same time, the excess of electrons on the negative plate gives it a negative charge that attracts the positive hydrogen ions. These ions, on reaching the plate, take on an electron and become neutral hydrogen atoms which rise to the surface. As hydrogen and oxygen ions disappear new ones are formed to take their place. This process continues until the water is exhausted. The positive plate is generally known as the *anode* and the negative plate as the *cathode*. The solution is called an *electrolyte*.

This rather complicated activity appears from point of view of the external circuit to be a steady direct current. We must remember, too, that conventional current *I* is said to flow in a direction opposite to actual electron flow in the external circuit. The electrolytic circuit just described is the simplest possible. Electrolytic circuits of industrial importance, such as batteries, plating vats and conduction circuits through the ground and bodies of water, are considerably more complex.

Current flow in plating circuits resembles the simple conduction circuit described except that there is more chemistry involved. In one type of copper plating circuit, a copper anode is used with an electrolyte containing copper sulfate and sulfuric acid. Copper sulfate dissociates into positive copper ions and negative sulfate ions. Copper ions like the hydrogen ions in the sketch, are attracted to the cathode (object to be plated). When the ions receive an electron and become atoms, instead of rising to the surface of the liquid, they become attached to the cathode, and gradually build up a layer of copper. Sulfate ions are attracted to the anode where they pull copper *ions* out of the metal to maintain a stable copper sulfate solution. When copper ions are removed from the anode they leave electrons behind that continue the current flow. The anode is gradually eaten away while metal is deposited on cathode.

Another type of electrolytic (*Continued on page* 194)

Here's why Wrought Iron Pipe serves longer at lower cost-per-year

Wrought iron pipe's longer life comes from its unique composition and structure. It is a two-component metal . . . high purity iron and glasslike iron silicate. The iron silicate is distributed throughout the iron in the form of threads or fibers. There are more than 250,000 fibers per sectional square inch.

These same fibers, illustrated in the magnified section above, give wrought iron its built-in protection against corrosion. When corrosion attacks, the network of these defensive fibers quickly arrests pitting and rapid penetration. As a result, corrosion is forced to spread out over the entire surface instead of penetrating the pipe wall, as happens in other materials. This effective safeguard against corrosion means that wrought iron pipe lasts longer at lower cost-per-year.

Service records in a variety of installations support this longer-life reputation of wrought iron pipe. Some of the applications where wrought iron is serving and saving are: heating system piping; air conditioning and refrigeration piping; water supply piping; sanitary system piping; sewage plant services; electrical conduit.

More of this story, and why you can use wrought iron pipe with confidence, is told in our booklet, *The ABC's of Wrought Iron*. Write for your copy today.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Division Offices in Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. International Division: New York, N.Y.

Available in Canada and throughout the world.

BYERS *Wrought Iron Tubular and Hot Rolled Products*

ALSO ELECTRIC FURNACE QUALITY STEEL PRODUCTS

"With a pork chop clamped between my teeth, I took to the handrails and scooted down below," roared Marmy

Marmy's superheated suction

► "BILGEWATER on Russian power plants," roared Marmaduke Surfaceblow as I placed our October '56, Russian issue before him at the Bent Propeller Bar. "I'll tell you bilge divers about a ship's plant I straightened out during the war. But I almost saw red and stripped my gears doing it." The old boy was primed to sound off. I grabbed a corner table and settled down to listen.

Our cantankerous consulting engineer backed his towering 6-ft 4-in. frame against the bar, gave his gray bowler the usual starboard list, hooked his huge fists into the armpits of his checkered vest, then glared at his audience. After the sound pressure level from his first blast dropped from 94 decibels toto a mere 20, Marmy roared away again in his foghorn voice.

"Back in 1943, I was a guarantee engineer for a shipyard in Quincy, Mass. They were turning out merchant freighters like sardine cans in those wartime days. My job was making trial runs and getting rid of machinery bugs before turning a ship over to the new owners.

"Those ships were fouled up in so many ways that I never knew what to expect. Sometimes, sloppy work by the haywire yard mechanics would show up during the full-speed run with the ship straining like a race horse on the homestretch. So taking one of those assembly line tubs out on trial was more fun than having a ringside seat at a holy roller's revival. After a few months, you either learned to get a laugh from some of the bonehead hookups or you ended up with a loose gusset stay in your noggin.

"One stormy winter morning, we shoved off from the yard for a trial run aboard the *SS Swallow*. She had a 7000-hp cross-compound steam turbine of 440 psi at 740 F. Pressure at the boiler's drum outlets was 480 psi.

"So many bugs showed up in the first few hours that we were shutting down and stopping every few minutes. I never saw a new ship's plant fouled up so badly. Check valves were installed backwards. Some of the electric cables were so undersized that one induced-draft fan's cable burned out during our full-speed run. A condensate return line was hooked up to the lube oil system. Several pumps were damaged from welding beads, rivets and even pieces of glass left inside the piping. We pulled a dead cat out of the freshwater pump's suction. Those were just a few things (*Continued on page* **200**)

The Power Plant Engineer Said:
"I WOULDN'T KNOW..."

INQUIRING REPORTER: So you use Nalco System water treatment ... How often are your boilers turbined?

ENGINEER: I wouldn't know—only worked here seven years. *

You recognize the Engineer's answer as a twist on the old one about *How-often-do-you-get-a-raise-around-here.* Our excuse for bringing it up is that the engineer's answer applies to hundreds of plants using Nalco water treatment. New plants, starting boilers from scratch with Nalco, report years on line, *billions* of pounds of steam generated in boilers that have *never* been turbined ... and probably never will be. Older plants, where turbining was as routine as checking the draft gauges, now open boilers only to show the inspectors.

These Nalco *results* can quite possibly be duplicated in your plant, regardless of the kind or severity of your water treatment problems ... or the size of your operation. Write or phone, now, for a fast start toward permanent water treatment security.

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6222 West 66th Place • Chicago 38, Illinois
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In Canada: Alchem Limited, Burlington, Ontario

THE Nalco® SYSTEM ... Serving Industry through Practical Applied Science

For higher pressures
— higher temperatures

JENKINS CAST STEEL VALVES

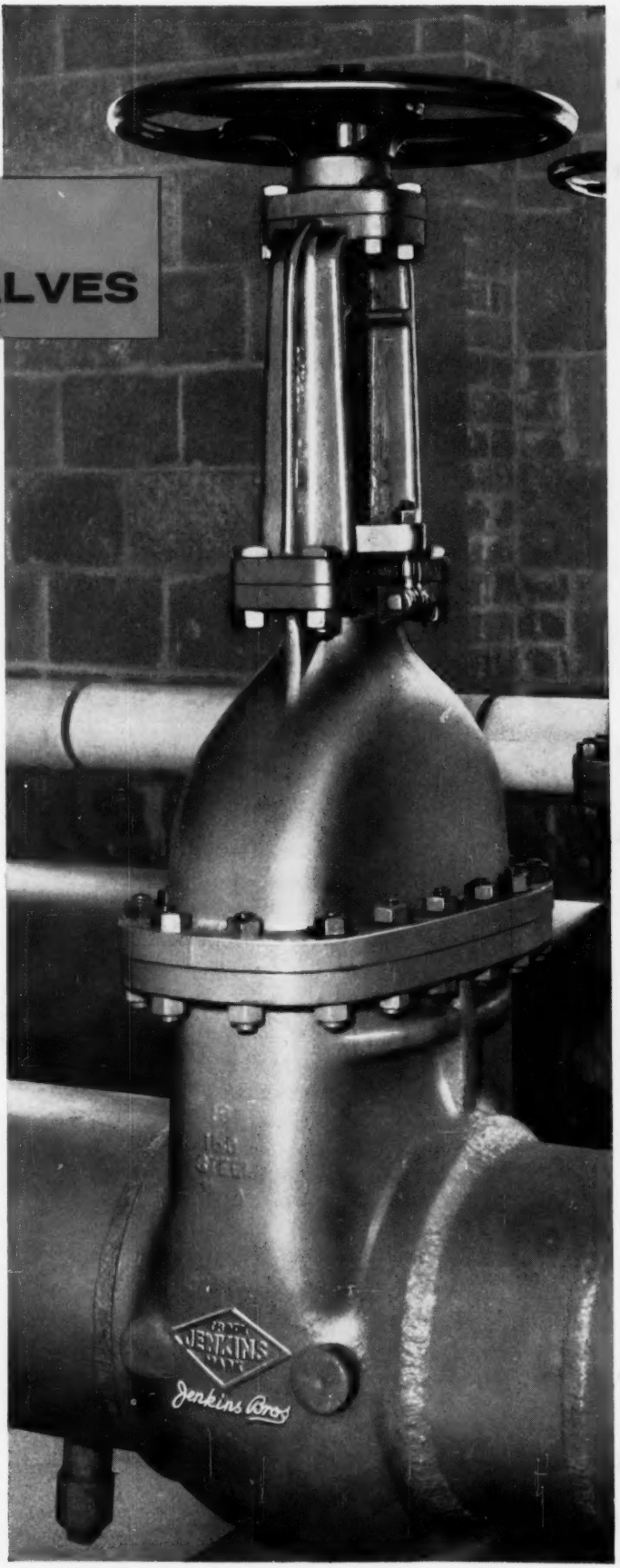
serve the systems planned for lowest operating costs

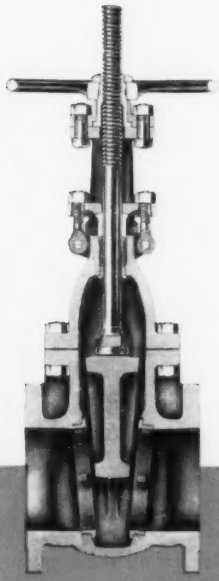
The steadily increasing number of power generation and industrial processing installations of Jenkins Cast Steel Valves is clear evidence of economy-minded selection by valve specifiers and buyers.

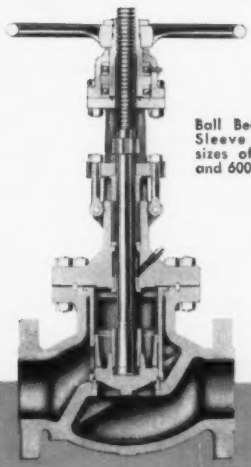
Jenkins Cast Steel Valves offer any required combination of casting alloys and seating metals for any service up to 600 lbs. pressure and 1000°F. temperature. Along with specified ratings, buyers get the plus of Jenkins *extra value,* in design, in construction, in quality standards.

Test Jenkins Cast Steel Valves at the most punishing control points in your plant. Compare performance, and you'll see how they set new standards for long-range economy.

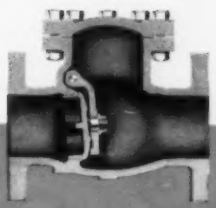
The Jenkins Cast Steel Valve catalog gives complete information. Get a copy from your Jenkins Valve Distributor, or write: Jenkins Bros., 100 Park Ave., New York 17.







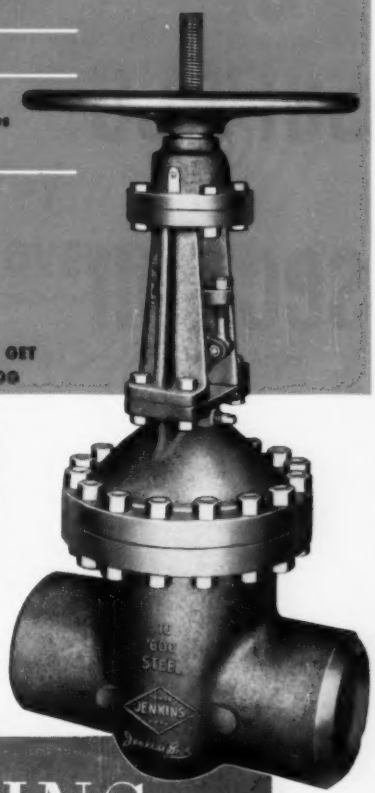
Ball Bearing Yoke Sleeve on larger sizes of 300, 400, and 600 lb. Valves.



PATTERNS	Gates 2" to 24" — Globes 2" to 10" — Angles 2" to 10" — Swing Checks 2" to 12". Non-return, stop and check Globes and Angles, 4" to 10" Screwed, Flanged, or Weld Ends
PRESSURES	150 lb. — 300 lb. — 400 lb. — 600 lb.
PRESSURE CASTING ALLOYS	Carbon Steel — 150 lb. Valves Carbon, Molybdenum Steel — 300, 400, 600 lb. Valves Chromium Molybdenum Steel
SEATING METALS	H Monel 13% Chromium Stainless Steel Carbon Molybdenum Steel, Stellite faced AISI Type 316 Stainless Steel

FOR COMPLETE SPECIFICATIONS GET THIS CAST STEEL VALVE CATALOG

It describes all patterns, casting alloys, and seating combinations, with details of the *extra value* design and construction features. Gives pressure-temperature ratings, dimensions, and other technical data covering the full range of Cast Steel Valves made by Jenkins Bros. Call your Jenkins Valve Distributor, or write: Jenkins Bros., 100 Park Ave., New York 17.



SOLD THROUGH PLUMBING-HEATING AND INDUSTRIAL DISTRIBUTORS

JENKINS VALVES

LOOK FOR THE JENKINS DIAMOND

TRADE JENKINS MARK

Reader service section

Start with these quick samples...

Space and time...

Each month, as the news reports pile up on our desk, we ask ourselves whether we'll have space to give them—whether you'll have time to read them. Now we think we've found an answer to this editorial dilemma. The answer? *Power Lines*—maximum coverage in minimum time. See if you agree. Turn to...

Reports From the Field, p 156

Going up...

in the world? Maybe we can make the ascent a little easier. Instead of losing sleep over lengthy tomes, try reading our digests of technical papers. Then if you still thirst for information, we tell you how to get the full report. For knowledge in a nutshell...

Technical Briefs, p 158

Off with the old...

equipment that's causing down-time in your plant. Make 1957 a real New Year with better production and fewer maintenance headaches. There's plenty of equipment to choose from, so before you buy, shop around for the best answer to your particular problem. A good place to start your window-shopping is with our...

Plant Equipment News, p 162

Penny wise...

and pound foolish—that's what you'll be if you fail to take advantage of the free manufacturers' bulletins offered here. For the price of a stamp, you can receive a raft of information on the latest equipment on the market. With performance charts and spec data before you, you're assured of making a wise purchase. Send now for...

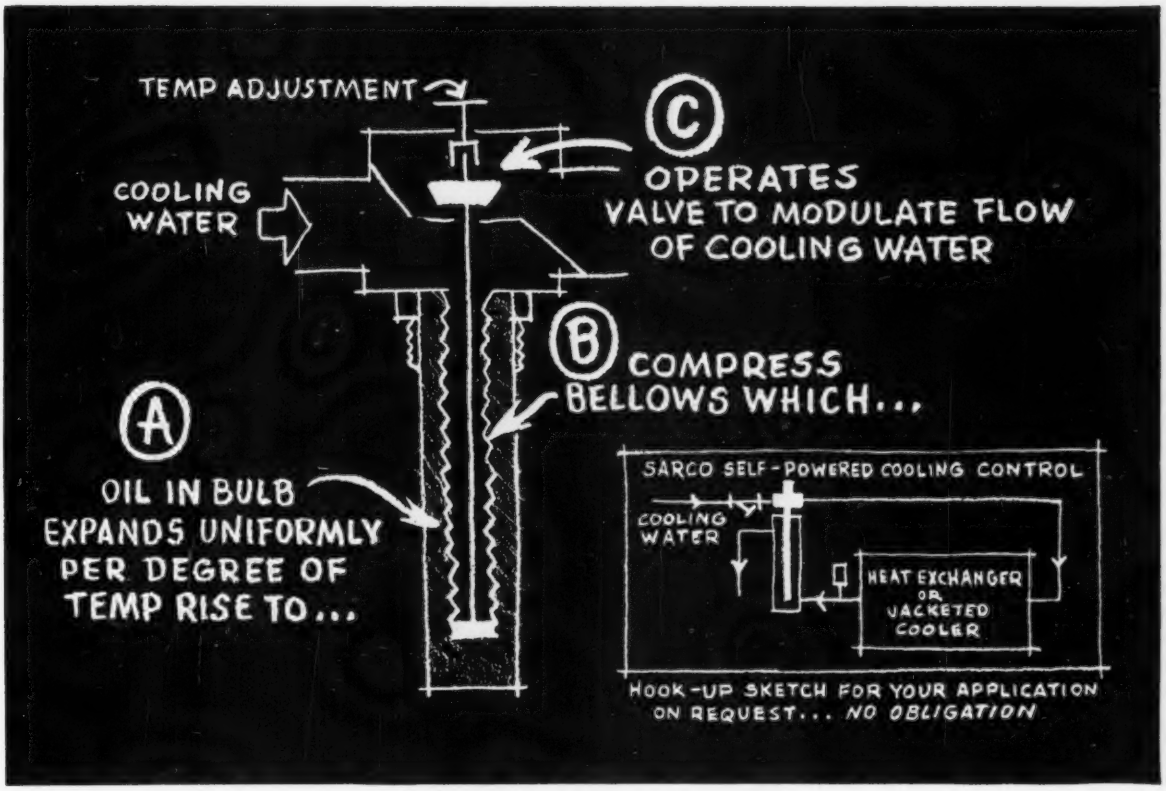
Free Literature, p 171

Regret it and forget it...

that's the only way to handle a mistake. You can't change what's happened, so don't waste time brooding. Many times our boners are blessings in disguise. If nothing else, they teach us tolerance. So chalk it up to experience when things go wrong and you'll emerge a wiser and a better man. Take it from one who knows...

George Edwards, p 174

For other timely ideas, see following service pages ▶


TEMP ADJUSTMENT
C
OPERATES VALVE TO MODULATE FLOW OF COOLING WATER
COOLING WATER
B
COMPRESS BELLOWS WHICH...
A
OIL IN BULB EXPANDS UNIFORMLY PER DEGREE OF TEMP RISE TO...
SARCO SELF-POWERED COOLING CONTROL
COOLING WATER
HEAT EXCHANGER OR JACKETED COOLER
HOOK-UP SKETCH FOR YOUR APPLICATION ON REQUEST... NO OBLIGATION

Simple, inexpensive way to end waste and hazards of overcooling

WHEN cooling water is manually controlled ...the operator is forced to play it safe by leaving the water valve wide open to compensate for variables in the load and water pressure and temperature. Result—*overcooling*. If he tries to vary the flow of water...he risks *undercooling*.

It pays to take responsibility off the operator's shoulders. Optimum *safe* temperature can be automatically assured by using Sarco Cooling Controls. They eliminate both overcooling and undercooling. They replace guesswork with certainty. Save man-hours and cooling water. Prevent damage to equipment.

Simple and Trouble-Free

Simple, trouble-free design—as you can see above, a temperature control need not be complicated! Self-powered...no electricity or compressed air required. Self-contained...no exposed mechanism. Packless...no packing to wear or leak.

Each year, thousands of these fully modulating and sensitive Sarco Controls provide dependable service for firms such as Ingersoll-Rand, Butler Manufacturing Co., and Swift & Co.

Low Price

The low price makes it possible for you to use Sarco AUTOMATIC temperature controls for ALL control jobs, not just the big ones! For example, the ¾" size costs only about $39! Mail the coupon now.

SARCO

Sarco Company, Inc., Empire State Bldg., New York 1, N. Y.
Please send information on your simple, inexpensive Self-Powered Cooling Controls for use on_____

Name_____
Firm_____
Address_____
City_____ State_____

2109-B

REPORTS FROM THE FIELD

What's happening in power and what it means to you

For Calendar of Events see page 232

X-ray traces atomic changes in metals

► THIS MONTH, the electrical industry took a second look at iron-aluminum alloys and liked what it saw. It appeared that, at last, these alloys could be put to work.

Hope came when research men at Westinghouse announced that they had solved the riddle of iron-aluminum. Using a super-power x-ray machine, the Westinghousemen uncovered changes in atomic arrangement that explained much about the baffling behavior of the metals.

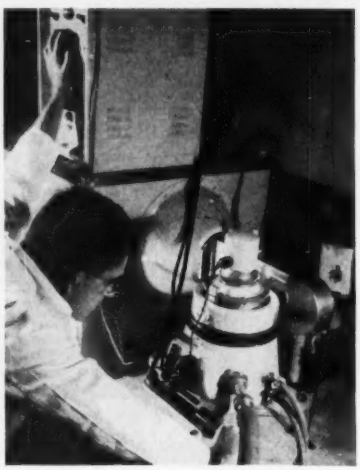
Iron-aluminum is attractive to manufacturers of electrical equipment because of its superior magnetic properties. But previous attempts to use it have been stymied by its skittish reaction to temperature change.

Research scientists, studying the metals, were able to observe the behavior changes but were unable to explain or understand them.

Then, Westinghouse applied its new crystallographic x-ray to the problem and came up with the answer.

Working at high speed, the machine took photographs of the alloys at the precise moment when, due to temperature changes, the magnetic arrangement of atoms in the metal underwent change.

With this new insight into the behavior of iron-aluminum, industry-men look forward to harnessing its potential. Meanwhile, Westinghouse has put its new baby to work on other puzzles.



WESTINGHOUSE RESEARCHER studies iron-aluminum through super-power x-ray

The Westinghousemen are confident of future successes. They point out that this x-ray is fifteen times more powerful than its contemporaries. This factor, coupled with its brilliant source, makes it possible to take x-ray photos in one-fifteenth the usual time, collapsing hours of work into minutes.

With this kind of speed at their command, researchers will be able to work on more complex projects at less cost and greater profit to industry.

Memphis launches massive power project

► A VENTURE into power production on a massive scale is being launched in Memphis, Tenn.

To provide a reliable source of electrical energy to its industries and swelling population, the city has disclosed plans to construct a power plant financed by an issue of approximately $154 million worth of tax-exempt electric revenue bonds. This is said to be the largest single offering of such bonds ever made by a municipality.

The program, say Memphis officials, also represents the largest single project of its kind ever undertaken by a community. It will enable Memphis to produce public power at the same rate level as the Tennessee Valley Authority. It proposes to do this without subsidy in the form of direct or indirect taxation.

The bonds will be repaid within 35 years from the city's Electric Division revenues. These will provide an overall debt service coverage ample to protect the huge investment.

Current cost of power purchased by Memphis (*Continued on page* 230)

Power Lines

Fears of future engineer shortages were somewhat allayed at this year's Power Show when a small boy declined POWER's offer of a balloon with a firm "No"—asked instead for a reprint of *Nuclear Energy Today*. (For full coverage of Power Show, see page 232.)

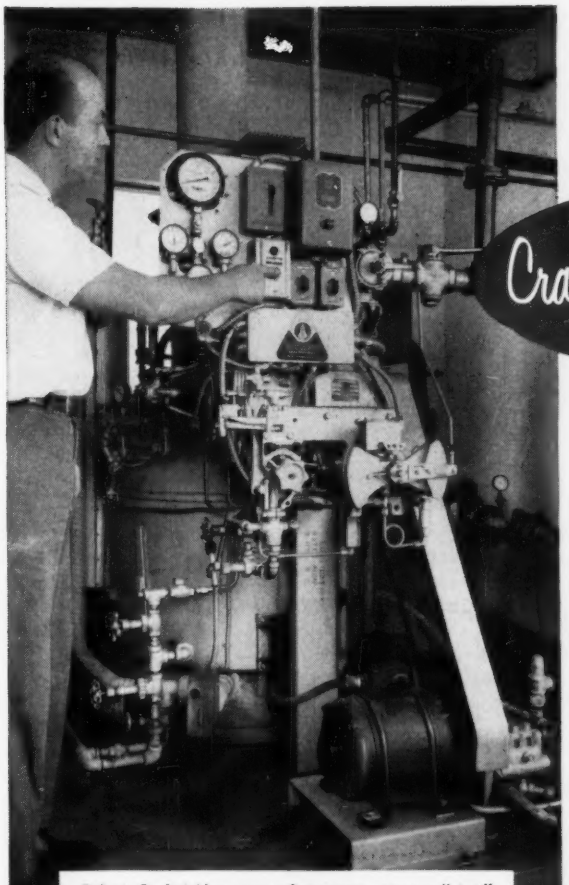
Japan is reported ready to buy a Calder Hall type atomic power station from Britain if various points of detail raised by a Japanese mission of atomic scientists and engineers are settled.

GE announced this month that it had begun work on a $2½ million over-speed test facility. Facility will be used to evaluate effects of abnormally severe operating conditions on material properties and design features of rotors while operating.

Central Electricity Authority announces that Britain's third civil atomic power station may be built on Bristol Channel at Inkley point in Somerset. Plans must now be approved by local planning authority and Ministry of Fuel & Power. Sites for first two stations have already been approved.

Bonn — (McGraw-Hill World News) The Mannheim firm Brown, Boveri & Cie AG has added a department for nuclear energy to their power plant division. New department is headed by Dr R Schulten. Company intends to design and build complete atomic power plants.

London circles believe that Israel's government is about to announce establishment of an atomic energy development project, with the eventual aim of setting up a full-scale atomic power program. Prediction is based on talks just concluded beween British and Israeli scientists.



Robert O. Stricklen, general manager, presses "start" button on 65-h.p. Modulātic with combination oil-gas burner at Cloverleaf Dairy, Ann Arbor, Mich. The base plate upon which complete unit was delivered measures only 4′ x 7′.

Starved for steam?

Cramped for space?

. . . here's how **Cloverleaf Dairy** solved both of these problems **— saved time and money, too!**

Like all dairies, Cloverleaf uses a lot of steam for pasteurization, cleanup, sterilizing milk bottles, sanitizing handling equipment and cans. They needed more steam than their old boiler could supply—and they needed more room—but the only possibility for plant expansion was a vacant space which scarcely held an automobile.

What to do? *Install a Modulātic Steam Generator, of course!* Today, in less than half of this small building-extension, Cloverleaf produces their full steam requirements, and uses the rest of the addition for storage. What's more, you'll now find washing equipment and a new storage tank where the old boiler room and coal bin used to be.

"But just as important," says Mr. Stricklen, "is Modulātic ability to give us plenty of steam at the constant pressure we want . . . to give us 2-minute steam from cold starts. Now we have no overnight firing, no waiting, no interruptions in production—yet our steam costs are at least 10% lower, without downtime or maintenance except normal servicing."

MODULĀTIC STEAM GENERATOR

— world's most compact power-package

MODULĀTIC FACTS IN BRIEF

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Pressures	2 to 1000 p.s.i.
Fuel	Oil, Gas, or Combination Burner
Floor Area (160 h.p.)	5′ x 8′
Height (160 h.p.)	6′-10″
Floor Load (max.)	150 lbs./sq. ft.
Operation	Automatic
Number in Use	Over 13,000

No separate enclosure, expensive stack, or special foundation needed. Multiple-unit installations can have a single, coordinated control.

If you use steam for heating, power, or processing, the self-contained, pushbutton Modulātic is a development you should surely investigate. It's clean, quiet, follows fluctuating load up or down with unmatched speed and accuracy—just set controls for the pressure you want, Modulātic does the rest! Why not mail the coupon *right now*?

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TECHNICAL BRIEFS

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20 Papers for you on
PIPING
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Piping for h-p, h-t steam

Metallurgical considerations of main steam piping for high-temperature, high-pressure service. *By H S Blumberg, The M W Kellogg Co.*

This paper discusses piping materials for power plants where temperatures up to 1200 F are contemplated. It concludes that a great many of the super-strength alloys for main steam piping seem to possess substantially greater long-time stress-rupture strength in the vicinity of 1200 F and higher than Type 347 and 316. But considerably more data on stability and weldability of these higher alloy compositions are required. Of the four classes of super-strength alloys (Cr-Ni-Fe, Cr-Ni-Co-Fe, Ni base, Co base) the first two seem to be worth further investigation.

The author summarizes available data for Type 347 and 316 and the super-strength alloys for an evaluation of their potentialities for 1200 F service. At present, for service temperature at which the austenitic steels are considered, Type 347 or 316 is selected, with the latter preferred. Two important factors are that (1) at higher temperatures Type 316 has received the highest ASME allowable stress ratings and (2) the material appears to possess better hot ductility properties. *ASME paper No. 56-A-157.*

Eight years of experience with austenitic-steel piping materials at elevated steam conditions. *By F P Fairchild, Public Service Electric & Gas Co.*

In three generating stations of the Public Service Electric and Gas Company, austenitic-steel pipe is in service in the main steam systems of seven turbine-generator units. The first of these has operated at elevated steam conditions since 1948.

In all, there are about 280 tons of the material in service in these stations. There has been practically no trouble with it, except where it is welded to other pieces of pipe or attachments.

Currently used power piping materials

Material type	Common name	ASTM piping class P No.	Chemical composition middle of range CR	MO	NI	V	CB	ASME allowable stresses (multiply by 1000) F 950	1000	1050	100	150	200	Recommended for temperature range
Ferritic	C MO	1	–	0.5	–	–	–	8.5	5.5	–	–	–	–	Below 850 F, graphitization occurs above
	1 CR 1/2 MO	12	1.0	0.5	–	–	–	11.0	7.5	5.0	2.8	1.55		825 – 950 F
	1-1/4 CR 1/2 MO	11	1.3	0.5	–	–	–	11.0	7.8	5.5	4.0	2.5		825–1000 F
	2-1/4 CR 1 MO	22	2.3	1.0	–	–	–	11.0	7.8	5.8	4.2	3.0	2.0	950–1050 F
	3 CR 1 MO	21	3.0	1.0	–	–	–	9.0	7.0	5.5	4.0	2.7	1.5	To 1000 F
	CR MO V X		1.0	1.0	–	0.2	–		10.0	X 8.5	X 6.0			To 1050 F
Austenitic	Type 347	TP 347	18	–	12	–	8XC min	13.85	13.5	13.1	10.3	7.6	5.0	Above 1050 F
	Type 316	TP 316	16.	2.	13	–	–	15.1	14.0	12.2	10.4	8.5	6.8	Above 1100 F

X Steel proposed by GE Co Under consideration but not yet approved by ASME code

Steam turbines having austenitic steel in piping and related parts

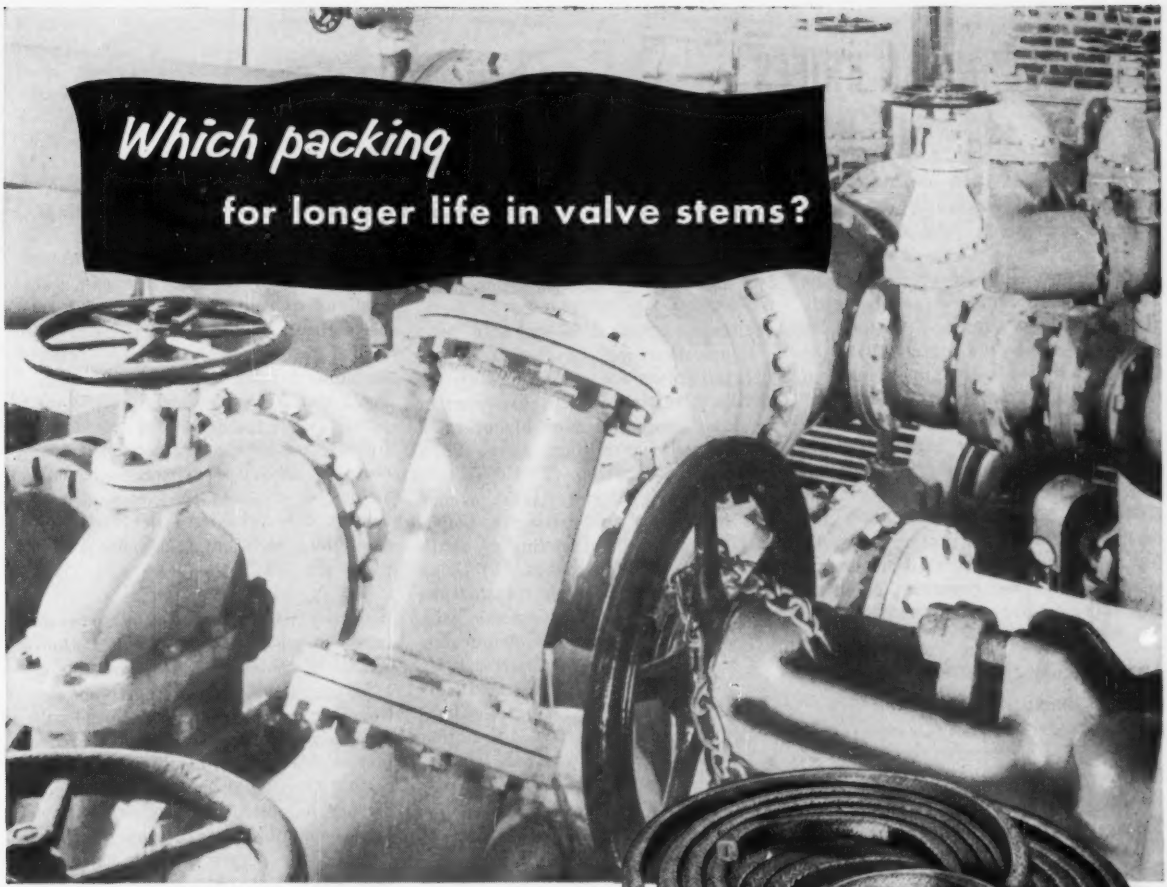
Location	In service	Turbine builder	Inlet temperature	(1) type	(2) nom cap	(3) tb piping	(4) plant piping
SEWAREN 1	1948	WE		TC	105	347	
SEWAREN 2	1948	GE		TC	100	347	
SEWAREN 3	1949	GE		TC	100	347	
SPORN 1	1949	GE		CC	125	347	
TWIN BRANCH 5	1949	GE		CC	125	347	
RIDGELAND 2	1950	WE		CC	150	347	
RIDGELAND 1	1950	GE		CC	150	347	
SPORN 2	1950	GE	1050 F	CC	125	347	FERRITIC
TANNERS CREEK 1	1951	GE		CC	125	347	
HUDSON AVE. 10	1951	WE		TOPPER	80	347	
SPORN 3	1951	GE		CC	125	347	
SEWAREN 4	1951	WE		TC	125	347	
TANNERS CREEK 2	1952	GE		CC	125	321	
SPORN 4	1952	GE		CC	125	321	
RIDGELAND 3	1953	WE		CC	150	347	
KEARNY 7	1953	GE		TC	145	347	347
KEARNY 8	1953	GE		TC	145	347	347
BURLINGTON 7	1955	WE		TC	185	347	347
LINDEN 2	1957	GE	1100 F	TC	225	347	316
AVON 8	1958	WE		TC	215	FERRITIC	316
BERGEN 1	1958	WE		CC	275	316	316
BERGEN 2	1958	WE		CC	275	316	316
PHILO	1956	GE	1150 F	TC	125	347	347
EDDYSTONE 1	1958	WE	1200 F	CC	325	316	316 Some G18B

NOTE:
(1) TC = Tandem compound CC = Cross compound (2) Megawatts (3) Between stop valves and turbine (4) Station piping between boiler and stop valves

A total of 517 principal shop and field welds were made in piping between boilers and turbines to put these systems together. Of these, 43 rewelds and 17 repairs were made in the first 174 joints; only one reweld and four repairs were made in the last 343 joints.

The author describes experiences with the material at each station, lists some of the welding techniques that have been developed over the eight years and points out some areas where there is need of further development. *ASME paper No. 56-A-181.*

Directions for ordering papers on p 228



. . . for heavy fluids, steam, water and gas . . . *it's J-M Jewett*®

Strong, tough Jewett has been proven the ideal packing for heavy duty valve stem service against crude and heavy oils, tar, molasses and other heavy gummy fluids. It also provides efficient sealing against steam; fresh or salt, hot or cold water; air; gas and some chemicals requiring a packing free from rubber.

The basis of Jewett's exceptional durability is its construction of high-quality long fibre asbestos yarn with fine copper wire inserts. This yarn is braided over a lead ribbon core and formed square. Style 10 is treated with a heavy bodied, heat-resisting lubricant which won't bleed in valve stem service. Furnished graphited in coil or ring form in sizes from ⅛″ up.

. . . for superheated steam and gases to 900F *it's J-M High Temperature*

When valves are operating in high temperature service, your best packing choice is Johns-Manville High Temperature Style 398. It retains its resilience, holds a tight, lasting seal against superheated steam and dry gases under elevated pressures and temperatures up to 900F.

To obtain this high sealing efficiency, Johns-Manville braids asbestos yarn of high purity over a plastic core of special heat resistant composition. For extra strength, the yarn is reinforced with tough heat and corrosion resistant Monel wire. The packing is formed square and then lubricated with mica. Furnished in ring, coil and spiral form in sizes ¼″ to 1″.

Your local J-M distributor carries full stocks of Jewett, High Temperature and other packings. Call him today or write Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario.

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JM PRODUCTS

More TECHNICAL BRIEFS

Begins on page 158

Creep characteristics of Type 347 stainless steel at 1050 and 1100 F in tension and compression. *By M J Manjoine, Westinghouse Research Laboratories.*

Cold-drawn and stress-relieved Type 347 heavy-wall tubing flows plastically at service temperatures (1050-1100 F) when subjected to a stress below the 10,000-hr rupture strength. Precipitation induced by the strain and temperature conditions causes an extended period of abnormally high creep resistance. The duration of this period increases with decreasing stress and is longer for compression than for tension. Creep and rupture strength for service duration over 10,000 hr are poorer than those reported for Type 347 annealed bar stock. *ASME paper No. 56-A-40.*

Also available:

Effect of stress on creep at high temperatures. *By H Laks, General Electric Co; C D Wiseman, O D Sherby, J E Dorn, University of California.*

Steam generation

Simplicity of station design and operation with cross-compound turbine-generator units. *By P E Benner, P G Brown, R C Buell, A G Mellor, General Electric Co.*

With the increasing demand for larger generating units, more electric utility companies are considering the use of cross-compound turbine-generator units for their new generating stations. This paper attempts to show that very little complication is introduced in generating-station design and operation by the use of cross-compound turbine-generator units.

There are two general types of cross-compound turbines available. The most frequently used consists of a 3600-rpm high-pressure element and an 1800-rpm low-pressure element. Units of this type, rated 260,000 kw, are in operation. A few units using 3600 rpm for both the high- and low-pressure turbines have been installed.

Advantages listed include the possibility of using conventionally cooled generators instead of the conductor-cooled generators that may be required with 3600-rpm tandem-compound turbines of the same capacity; savings in turbine room space and in reduction of the required turbine room crane span. *AIEE paper No. CP 56-998.*

Directions for ordering papers on p 228

Steam station auxiliary systems for large high-pressure turbine-generator units. *By A C Dolbec, J J Heagerty, A G Mellor, General Electric Co.*

This paper compares various auxiliary system arrangements for units from 200,000 to 600,000 kw at steam pressures of 2000, 3500 and 4500 psig.

Conclusions include the following: (1) It is more economical to keep the auxiliary system at 4.16 kv—whether by using more buses or higher rated 4.16-kv switchgear—than to go to a higher voltage system. (2) Use of two-stage pumping (series stages) or motors in tandem for driving a boiler-feed pump aids in designing an auxiliary system with four buses. (3) Using split low-voltage winding transformers offers an opportunity for economic gain. (4) Selective throwover of motors during an emergency throwover is a practical method of operation which extends the use of a particular rating of switchgear. (5) Induction motor contribution to interrupting duty should be considered. *AIEE paper No. CP 56-997.*

Economic studies applied to industrial power systems. *By H B Backenstoss, Jackson and Moreland.*

Industrial plants are quite understandably governed principally by the problems associated most directly with production. It is important, naturally, to concentrate the talents of plant management on the larger elements in the cost of the finished product because new ideas can be very effective here in creating savings in cost or increasing output. It is not surprising therefore that the cost of electric service, particularly in respect to investment requirements for the necessary physical plant, is likely to receive less attention.

A procedure often adopted in plants where power does not enter heavily into the cost of the finished product is to plan new installations or make changes in production facilities with only incidental regard to the problems of electric supply and thereby oblige the electrical planning engineer to furnish power to the production equipment as best he can. This does not always lead to an electrical system of optimum cost. It may not lead to minimum long-term cost of the total production facility.

A method of evaluating future costs and giving them their proper weight against present costs is presented and explained in the paper, together with several examples to illustrate its application. *AIEE paper No. 56-22.*

Corrosion

Control of corrosion with zinc coatings. *By J L Kimberley.*

This paper covers briefly the history of the uses of metallic zinc and zinc coatings to control corrosion and the basic theory under which zinc is protective to steel. Methods of application including hot-dip and electro galvanizing, metallizing, Sherardizing and painting are outlined and discussed. Relative merits and weaknesses of zinc coats are indicated as well as general statements covering the fields of usefulness, case histories and overall considerations, including economics. *NACE paper No. 56.*

Reducing maintenance painting costs in the chemical industry. *By M L Monack, H W Shockley and J R Allen.*

Maintenance painting costs in the chemical industry can be reduced appreciably by taking measures necessary to increase life of coatings and by cutting their application cost. Longer life can be obtained by following three primary requirements of proper surface preparation, proper coating selection and proper use. Application cost can be cut by using designs with less surface area, using tapes as auxiliary protection, applying coatings by the hot-spray method and using high solids content paints with fewer coats.

This paper briefly reviews requirements for obtaining long coating life, details methods for cutting application cost. *NACE paper No. 34.*

An outline of a physical theory of underground corrosion. *By Gordon N Scott.*

An attempt is made to account for the rate of accumulation of leaks on a pipe line. In addition to the theoretical development, evidence in support of the theory and a discussion of consequences of practical importance, are included.

The paper is limited to an outline of the theory. It begins by assuming the corrosion rate decays inversely with its progress. If for extensive structures it is assumed that effective electrochemical potentials at work are essentially constant, it follows that the dominant variable is environmental electrochemical conductivity. Thus is the total corrosion related to time, electrochemical potentials extent and soil conductivity.

Since at a fixed time corrosion at each point of attack is associated with a

(*Continued on page* 220)

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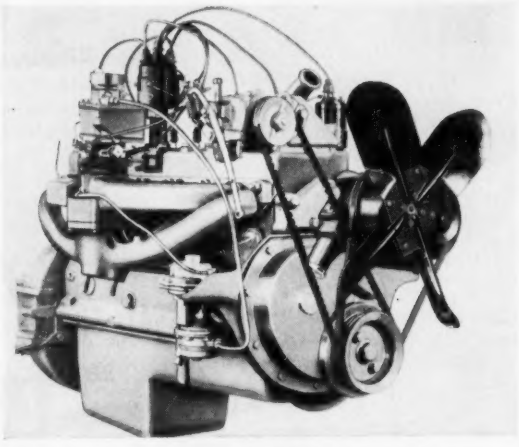
Reactors: stepless control to 500 kva

101 • Saturable reactors range in output from .3 to 500 kva, for manual or automatic control of power to a load. This transformer-type device is suited for stepless control of electrically heated equipment, reduced voltage in ac motor-starting circuits, and loading reactors for test boards, according to manufacturer. By changing the magnetic characteristics of the reactor core, impedance can be varied by means of a dc control winding. This enables reactor to provide a wide range of stepless control in the ac power circuit, with smooth and easy adjustment over the entire range. Details from manufacturer.

Hevi Duty Electric Co, Highland Ave, Milwaukee, Wis.

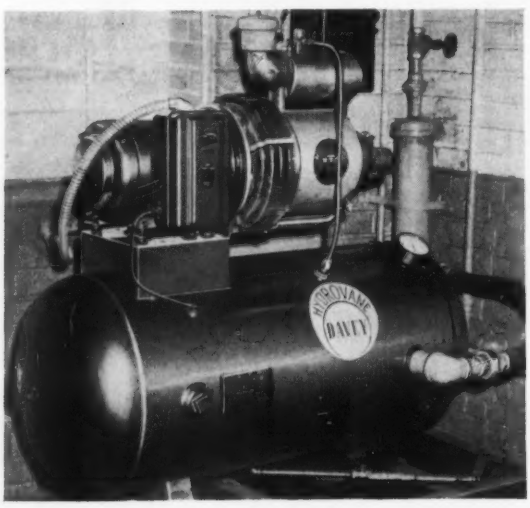


Jeep engine offered for industrial use

102 • Heavy duty 6-cylinder engine is designed to produce high torque at low speeds. At 2600 rpm, engine carries a continuous ratio of 65 hp. According to manufacturer, extra durability has been provided for every engine component that may be subjected to excessive wear. Stellite or Eatonite material is used for unit's valves, with Stellite or Eatonite valve inserts and positive rotation for long life. According to manufacturer, this reduces valve warpage, seat distortion and valve burning. Pistons are of aluminum alloy, each with a control band. Band is cast into piston around skirt for long life.

Willys Motors, Inc, 1445 N Cove Blvd, Toledo, Ohio

For more data on these items, use post cards, page 171. Identify your request with item number

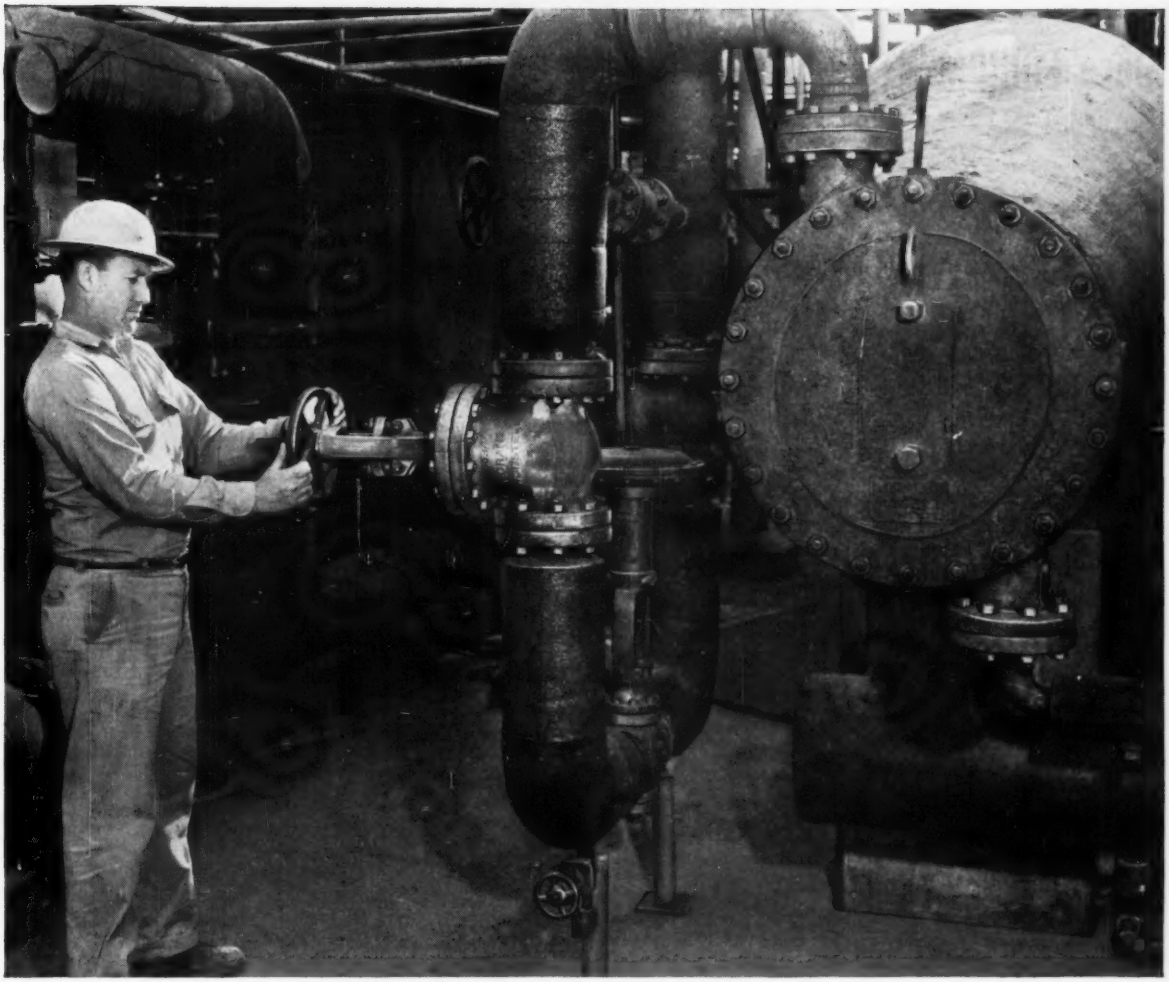


Air compressor boasts low vibration

103 • Five-hp tank-mounted rotary compressor has displacement of 21 cfm. It is direct connected to an 1800-rpm 5-hp electric motor and is available with modulation, start-stop or combination modulation-stop-start control as desired. Maximum working pressure is 200 psi for continuous operation. For intermittent use, compressors may be operated at 250 psi. Units are available with either horizontal or vertical air receivers (tanks).

Rotor-stator arrangement, in combination with two multistage cooling oil injection chambers, is said to compress air more efficiently, more quietly, with less vibration and at a lower temperature than is possible in other 2-stage designs, according to manufacturer. It is said that unit possesses fewer working parts than other compressors of either rotary or reciprocating types. Horizontal tank unit is 25-in. wide, 48-in. long, 44⅜-in. high. Vertical unit is 25-in. wide, 35¼-in. long and 72½-in. high.

Davey Compressor Co, Myers Ave, Kent, Ohio



This Crane valve joins the "12-year service club" on steam

Valve performance like this looks good on any plant's cost sheets.

In 1944, Eastern States Petroleum Company installed this Crane 4-inch 33XR steel gate valve in its Houston refinery, handling 150 pounds of steam at 375° F. It's a busy valve—operation is frequent.

Despite the fact that this Crane valve has an even dozen years of severe service—with opening and closure at close intervals—*no* maintenance or service has been required except repacking.

Before you lift an eyebrow in surprise, consider the fact that Crane valves have performance records like this throughout industry, on all types of flow control. There's a logical reason, of course: Crane valves are strictly quality *all* the way—from research and engineering through precision manufacturing, assembly and testing methods.

Any wonder why men who know valves say *Crane is the name to depend on?* Don't gamble with your all-important flow control—specify Crane valves and fittings from the world's largest line, built with a century of matchless experience. Get the facts from your local Crane Representative, or write to the address below.

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PIPE • KITCHENS • PLUMBING • HEATING

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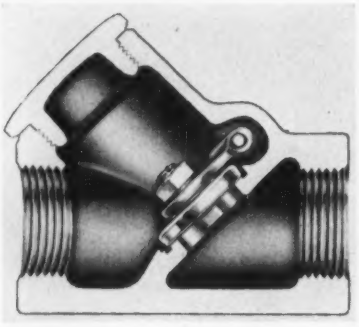
Begins on page 162

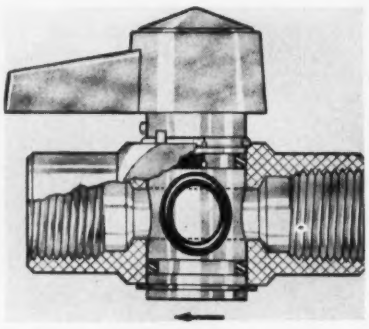
Here are six ways to simplify your plant's valving, flow-control problems



Regrinding swing-check valve

104 • Y-type valve has pressure ratings of 150 WSP/300 WOG and 200 WSP/400 WOG. Ten sizes range from ¼ to 3 in. Size and pressure are clearly marked. Direction of flow arrows shows on both sides. Body is cast from bronze alloy; other parts are of brass rod or bronze alloy. Removing valve from line is unnecessary when seat and disk wear on this type valve. Easy regrinding.

Ohio Brass Company,
100 Surrey Road, Mansfield, Ohio



Low-maintenance plug valve

105 • Valve is said to provide leakproof shutoff. Unit is operated by handle that opens and closes easily against pressure. Three O-rings are utilized in the design. In closed position, one ring serves as flow seal for tight shutoff. In open position, valve is full ported and allows straight-through flow passage. Rings at top, bottm and around plug prevent stem leakage.

Circle Seal Products Co, Inc,
2181 E Foothill Blvd, Pasadena, Calif.

Polyvinyl chloride valves

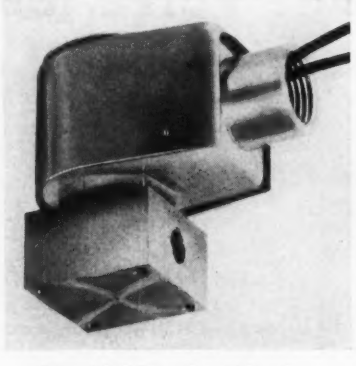
106 • These general-purpose rigid valves are designed to withstand high temperatures and high pressures. Valves operate up to 170 psi, continuous duty, and in lower pressure systems may be used safely at temperatures to 170 F, or higher for intermittent duty. They are said to have corrosion resistance, constant flow characteristics, and immunity to electrolysis and galvanic action.

Chemtrol Corporation,
11008 Santa Fe Ave, Lynwood, Calif.

Multi-use solenoid valve

107 • Flow control of 12 common fluids, through 42 different valve styles and capacities, and with any one of seven electrical circuits, is obtainable through use of multi-voltage coil. Valves range from 7/64 to 1½-in. port sizes.

Jackes-Evans Manufacturing Company,
4427 Geraldine Ave, St. Louis 15, Mo.



Liquid CO_2 solenoid valve

108 • Two-way, shutoff solenoid valve is designed for cooling applications using liquid CO_2. It can be used in low temperature tumbling barrels and environmental test chambers where constant temperature control is vital.

Automatic Switch Company,
391 Lakeside Avenue, Orange, N. J.

Solenoid valve-fin control

109 • Solenoid valve provides independent controls for manual opening and adjustment of flow, opening and closing speed. *Type HV* can be mounted on piping running at any angle. Sizes range from ½ to 2 in.

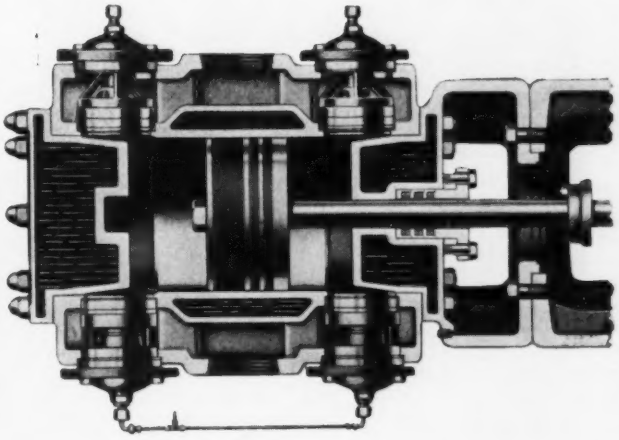
J D Gould Company, 4707
Massachusetts Ave, Indianapolis, Ind.

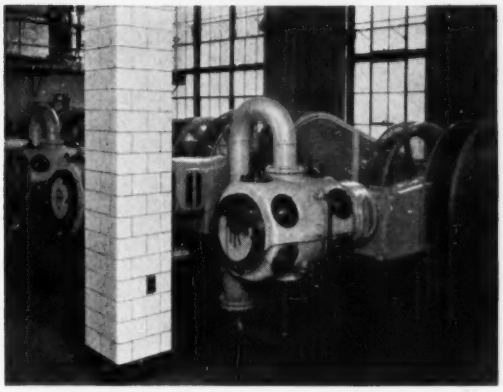
For more data on these items, use post cards, page 171. Identify your request with item number

A dependable supply of oil-free air or gas

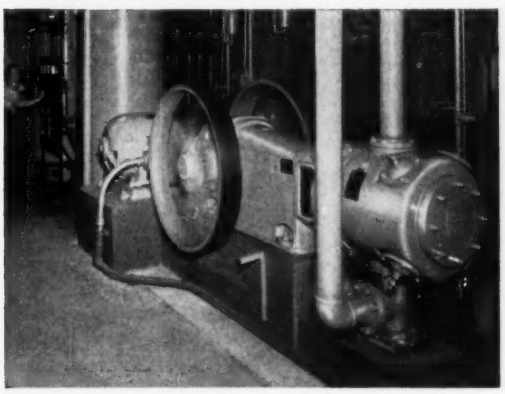
Graphitic-carbon wearing rings and pressure rings prevent metallic contact between the piston and cylinder bore—no oil is used anywhere in the compression cylinder or on the piston rod.

NL Channel Valves are designed specifically for non-lubricated service. Carbon guides protect channel ends and special Teflon strips protect channel interiors and spring ends from metal-to-metal rubbing and wear.





Installed in a large brewery in 1933, this Ingersoll-Rand ES-NL compressor was the first unit ever built with non-lubricated cylinders. It is still in daily service, providing the clean, oil-free compressed air which is vital to product purity. Three other ES-NL compressors, installed since then, are shown in the background.



One of four ES compressors with NL cylinders, supplying oil-free air in the manufacture of super-precision instruments and aircraft ball bearings.

with Ingersoll-Rand ES-NL compressors

In process and manufacturing plants all over the world, the problem of oil contamination in compressed air and gases has been successfully solved by the application of Ingersoll-Rand ES-NL compressors.

The unique NL cylinder design provides compression without oil lubrication—through the use of graphitic-carbon wearing and pressure rings. The ability of these compressors to deliver clean, oil-free air and gas, in continuous, heavy-duty service, has been thoroughly proved in every field of application.

If you have an application where oil-lubricated compressor cylinders cannot be used, ask your Ingersoll-Rand representative about the ES-NL compressor, sizes 5 to 150 horsepower—other Ingersoll-Rand NL compressors to 1000 hp.

Ingersoll-Rand

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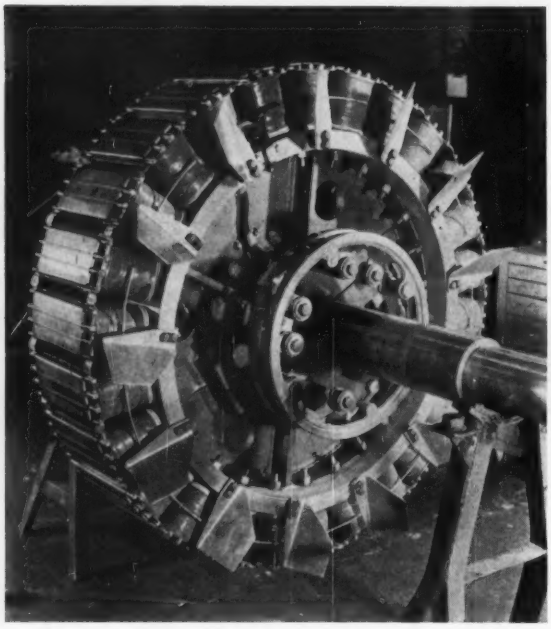
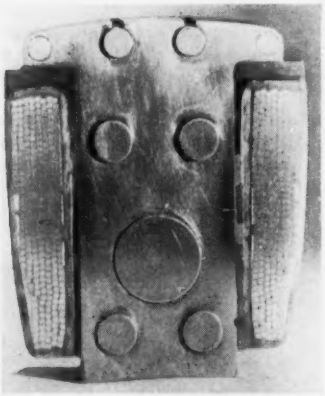




SECTION through salient rotor pole with integrated field coil illustrates the bonding of coil and locking at pole surfaces. Supporting collar is part of the structure. According to manufacturer, the smooth exterior surface shrugs off contaminants

Insulating system offers more protection for motors, generators

110 • Integrated field coil with a newly developed insulating system is designed to protect electric motors and generators against atmospheric contaminants and destructive mechanical forces.

It is said that integrated field coil construction is well suited for applications requiring chemical resistance, oil and moisture-proofness, or sealing against atmospheric contaminants such as carbon black, dust and dirt. It is currently available for synchronous and dc machines subject to severe duty cycling in Class A and B temperature classifications. Studies indicate, however, that the system will eventually be available for Class H temperature applications.

Primary insulation is glass, with fibers tailored and oriented for maximum strength. Solventless types of inorganic, heat-stable resins augment glass fibers. Resins bond with coil conductors and pole surfaces, fusing structure into one integral part. Enveloping skin is locked with coil and pressure molded to coil contours. Unit requires little care; resists heat shock.

Allis-Chalmers Manufacturing Co, 952 S 70th St, Milwaukee, Wisconsin

For more data on these items, use post cards on page 171. Identify your request with item number.

Pneumatic signals changed to dc

111 • Mechanical and pneumatic signals can now be converted to dc current for long-range transmission and then reconverted to pneumatic pressure for actuating control valves or other pneumatic equipment.

It is said that new system permits low-cost remote measurement, indication, recording and controlling of process variables by eliminating electronics and complex circuitry. Transmitter unit uses a flexure mounted beam and pneumatic nozzle as an error detector and power amplifier to convert a pneumatic signal to an electric signal. Unit converts pneumatic signals of 3-15 psi or equivalent mechanical output into 3-15 ma dc current for electrical transmission. Receiver then converts this dc signal to pneumatic pressure of 3-15 psi.

Fielden Instrument Div, Robertshaw-Fulton Controls Co, 2920 North Fourth Street, Philadelphia 33, Pa.

Explosion-proof portable hand lamp

112 • Unit is designed for safe yet practical lighting in flammable atmospheres, such as in the interiors of fuel tanks during cleaning or painting operations.

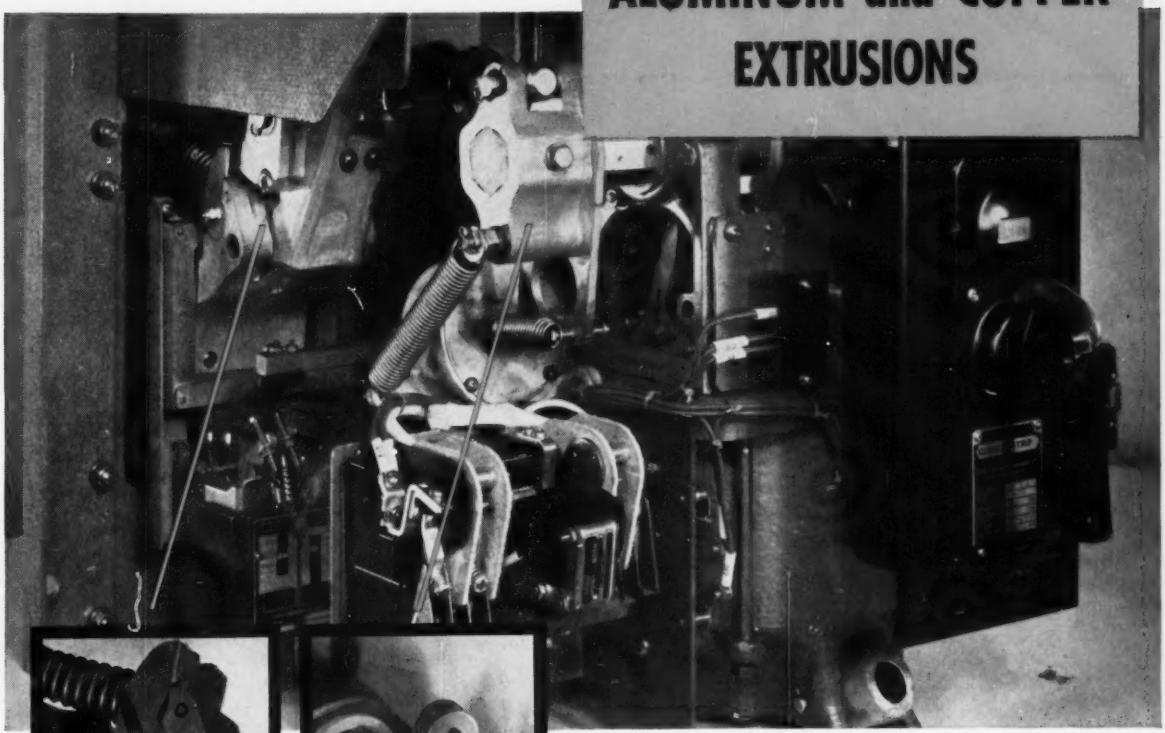
Fixture weighs less than 11 lb and uses 150 watt Par-38 reflector type spot and flood lamps, which produce a concentrated light pattern. Unit is UL-approved for Class I, Group C, locations (atmospheres laden with flammable mixtures of ethyl-ether vapors, ethylene, or cyclo-propane) or Group D locations (atmospheres containing hazardous quantities of gasoline, hexane, naphtha, benzine, butane, propane, alcohol, acetone, benzol, lacquer solvent vapors, or natural gas).

Cone-shaped aluminum body is ridged with heat-dissipating fins. Plastic coated fiber handle remains cool to touch after lamp has been in use for long periods.

Crouse-Hinds Co, Wolf & 7th N Sts, Syracuse, N. Y.

REVERE
ALUMINUM and COPPER EXTRUSIONS

I-T-E CIRCUIT BREAKER—KD (3,000 amp. rating) showing progressive assembly with Revere Copper and Aluminum Extrusions in place. I-T-E Circuit Breaker—KE is same type with 4,000 amp. rating.



COPPER
for conductivity

ALUMINUM
for economy

—form a Money-Saving team in latest I-T-E CIRCUIT BREAKERS

Revere T. A. Service an Important Factor in Ultimate Design of Parts

The larger of the two extruded and drawn copper shapes shown at extreme left started out on the drawing board as two pieces. It was thought that a single shape of this size could not be made satisfactorily. At this point, I-T-E Engineers got together with Revere's T. A. (Technical Advisory) Service and threshed things over. The final result is the one-piece extrusion shown and a reduction in machining time.

Aluminum was selected for the other extrusion shown because I-T-E found that it cost less per pound of metal and had a higher strength ratio when compared to a casting. Also, space was a factor. In all, Revere supplies 5 copper and 2 aluminum extrusions for KD and KE type I-T-E Circuit Breakers. All were designed to fit specific requirements of I-T-E Engineers. Where it could be used satisfactorily, aluminum was applied because of economy, while current carrying members called for copper.

This is still another example of Revere supplying the metal that will do the best job and with the greatest economy . . . be it aluminum, copper or any one of their alloys. So, with new things happening all the time in non-ferrous metals it can pay you to keep in close touch with Revere.

COPPER ★ BRASS ★ 1801 ★ REVERE ★ ALUMINUM

REVERE COPPER AND BRASS INCORPORATED
Founded by Paul Revere in 1801
230 Park Avenue, New York 17, N. Y.

Mills: Baltimore, Md.; Brooklyn, N. Y.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Newport, Ark.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere.

More EQUIPMENT NEWS

Begins on page 162

Plastic insulation molds itself to surface

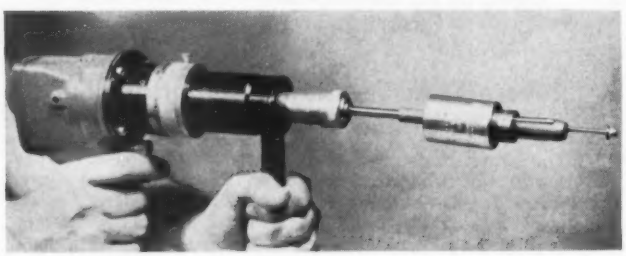
113 • Flexible, foamed-plastic sheet insulation adapts itself to curved or irregular surfaces with little or no fitting or cutting, according to manufacturer.

Flexibility of sheet form makes it particularly adaptable to insulating large tanks, irregularly shaped vessels, oversize pipes, and refrigeration and air-conditioning equipment.

Material will withstand temperatures as high as 160 F, with no limitation at the low end of the temperature scale, since thickness can be built up by applying successive layers.

Sheets have a k factor of 0.28 at 75-F mean temperature and a water vapor permeability of 0.1 perm. They are available in thicknesses of ⅛, ¼, ½ and ¾ in sheets 30x36 in. Sheets can be applied to almost any surface with adhesive. Need no mechanical supports.

Armstrong Cork Co, 1010 Concord St, Lancaster, Pa.



Air magnetic control used for tube expanding

114 • Air magnetic control utilizes torque control for tube expanding. Operation is based on powerful permanent magnet that gives positive and instantaneous engagement and disengagement between driving mechanism and driven expander. Control is air driven and therefore suited for rolling tubes in hazardous locations. Unit weighs 10 lb, measures 10½ in. long and according to manufacturer is well balanced for ease in handling. Request details.

Elliott Company, Springfield, Ohio

To receive additional information on these new equipment items, use the handy post cards provided on page 171. Identify your request with the item number.

Pump seal designed for long life

115 • Boiler-feed pump mechanical seal is designed to provide long service life. Once installed, seal needs no further attention and replacement of expensive sleeves is eliminated, according to manufacturer. It is said that loss of feedwater is prevented, since there is no leakage.

Long seal life is obtained through use of a special closed circulating system, which provides cool water in sealing chamber.

Seal comes fully engineered for particular operation, including adaptation to pump design and piping arrangement. Plans are furnished. All necessary recommendations are supplied and heat exchanger size is specified. Request additional details from manufacturer.

Crane Packing Company, 6410 Oakton Street, Morton Grove, Illinois

Fire-resistant hydrolubes cut wear

116 • These improved hydrolube fluids are corrosion and wear resistant. Manufacturers claim that wear resistance is in the same general range as petroleum hydraulic oils. It is said that tests have shown improved vapor phase corrosion protection for ferrous metals over that of previous formulations. Manufacturers claim that CP hydrolubes have no harmful effects on packings or seals. They are said to have good shear stability, high viscosity indexes and low pour points. Ordinary filters may be used.

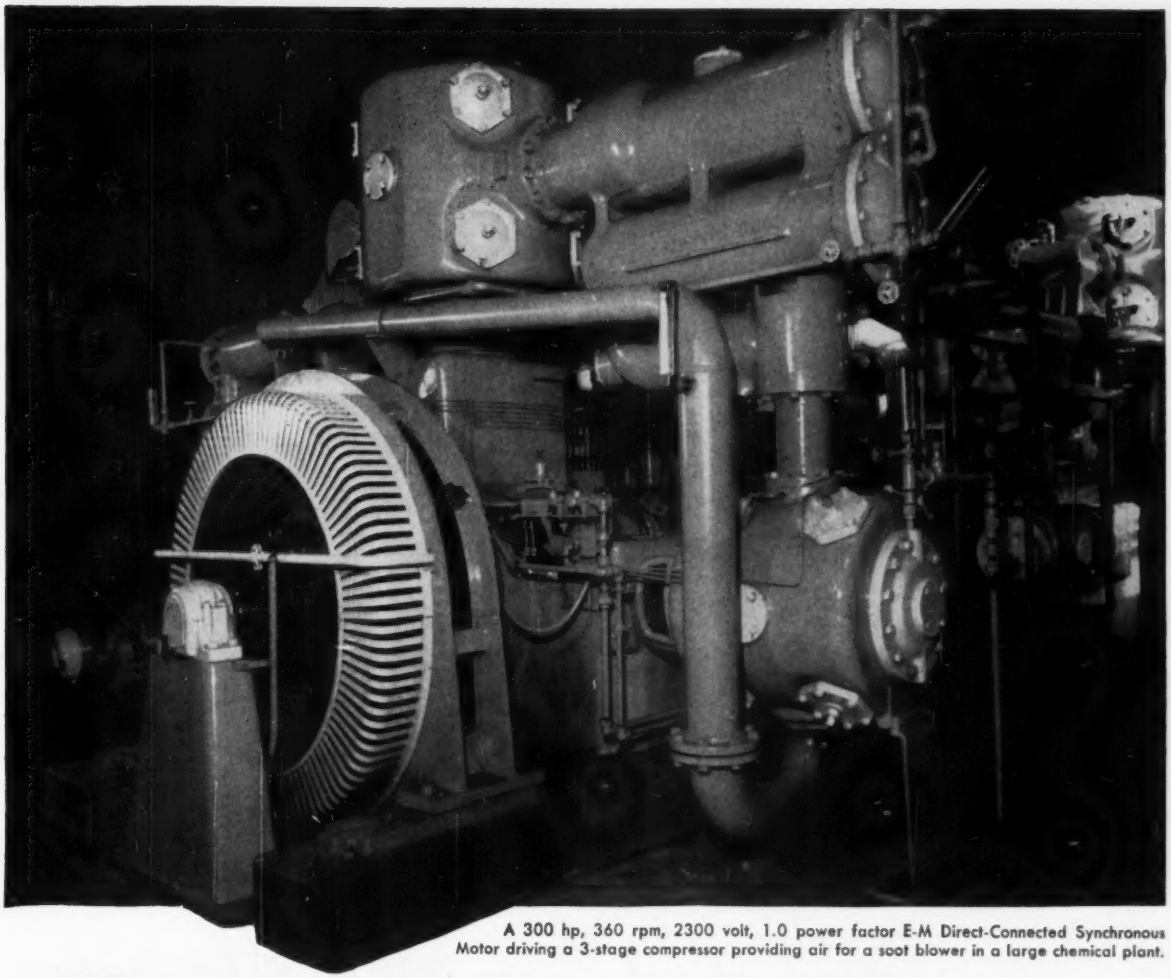
Carbide and Carbon Chemicals Company, 30 East 42nd Street, New York 17, N. Y.

Be sure to check this item . . .

Evaporation barriers . . . . . p 182

. . . and these and the many others appearing on pages noted below:

Differential transmitter . . . . . p 176
Universal steam trap . . . . . p 180
Duplex lubricator . . . . . p 184
Portable pH recorder . . . . . p 186
Electric rotary hammer . . . . . p 188
Linear ball bearing . . . . . p 190
High-velocity control unit . . . . . p 192



A 300 hp, 360 rpm, 2300 volt, 1.0 power factor E-M Direct-Connected Synchronous Motor driving a 3-stage compressor providing air for a soot blower in a large chemical plant.

What every new compressor should have

● Nicest thing you can do for a new large compressor is to couple an engine-type synchronous motor to it. There's no better way to assure a most economical, reliable and trouble-free drive. Look at the advantages:

1. HIGH EFFICIENCY conversion of electric power to mechanical power by synchronous motors . . . resulting in minimum electric power cost operation of the compressor.

2. POWER FACTOR CORRECTION by unity or 0.8 leading power factor synchronous motors . . . supplying leading reactive kva to improve plant power factor and further reduce power costs, save money on your power bills.

3. DIRECT-CONNECTED synchronous motors save valuable floor space and require minimum maintenance.

4. SIMPLE STARTING at full voltage is suitable for most direct-connected synchronous motor compressor applications. Or you can use E-M-invented part-winding starting where starting limitations are severe. E-M starting arrangements are low in first cost and maintenance cost.

And there's nothing nicer for your compressor than an *E-M* Direct-Connected Synchronous Motor. E-M, pioneers in the development of synchronous motors and control, have over 40 years' experience in the design of synchronous motors incorporating desirable characteristics and features such as those above.

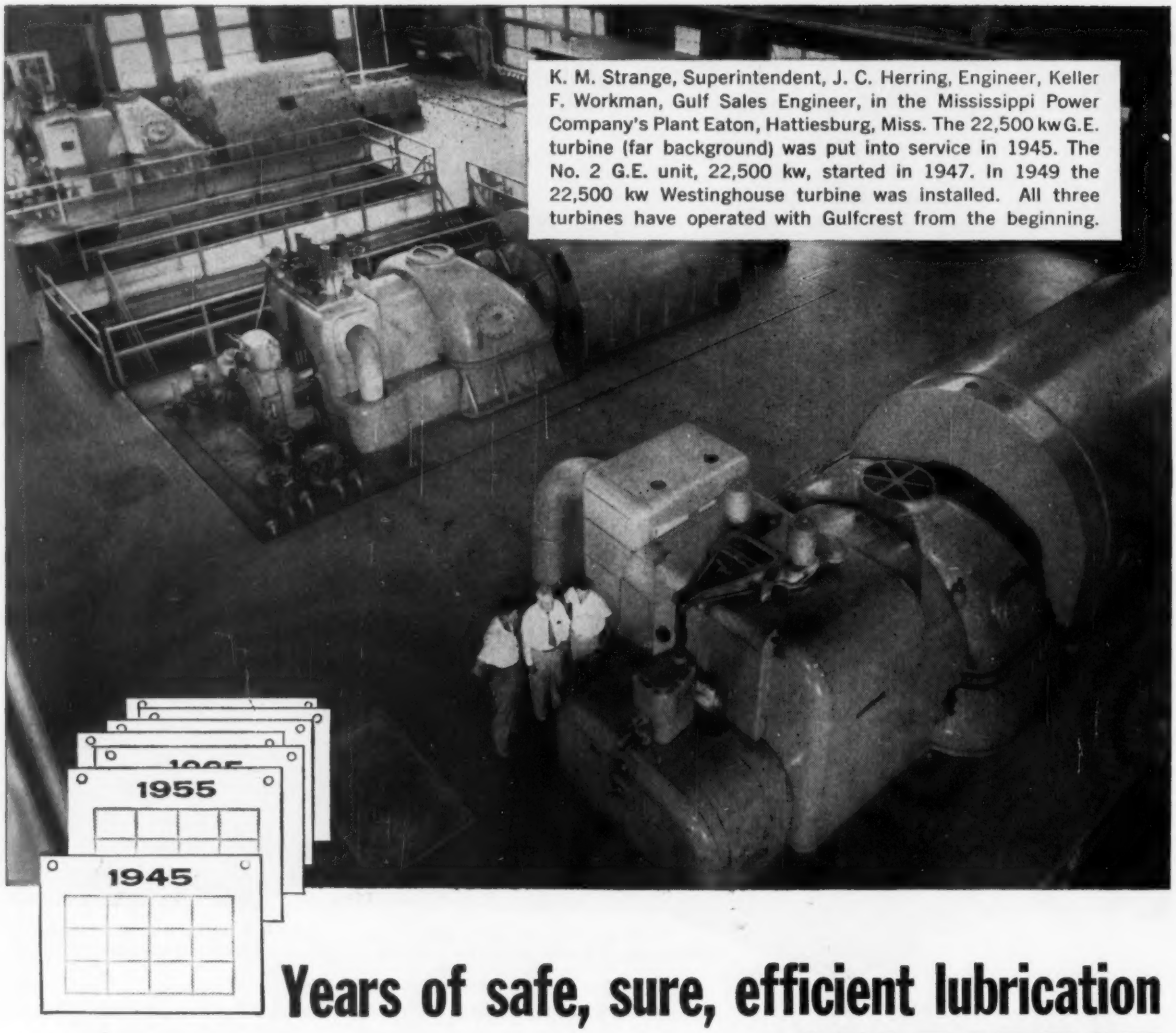
Let the E-M specialist engineer team design a smooth-running, modern drive unit to meet the requirements of your new compressor application. For complete information on E-M Synchronous Motors and their application in your plant, consult your nearest E-M sales engineer. And write for the issue of the E-M Synchronizer titled "The ABC of Synchronous Motors".

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

1200-TPA-2136

E-M

SPECIALISTS IN
BIG MOTOR ENGINEERING



K. M. Strange, Superintendent, J. C. Herring, Engineer, Keller F. Workman, Gulf Sales Engineer, in the Mississippi Power Company's Plant Eaton, Hattiesburg, Miss. The 22,500 kw G.E. turbine (far background) was put into service in 1945. The No. 2 G.E. unit, 22,500 kw, started in 1947. In 1949 the 22,500 kw Westinghouse turbine was installed. All three turbines have operated with Gulfcrest from the beginning.

Years of safe, sure, efficient lubrication ahead for these turbines with GULFCREST

Gulfcrest's unmatched record of performance in every type of steam turbo-generator guarantees safe, sure, efficient protection for these three units down through the years.

These units have operated with clean lubricating systems since going into service—no rust, sludge or foam. At last check, neutralization numbers were as low as ever.

Gulfcrest, super-refined by Gulf's exclusive Alchlor Process, lasts indefinitely. It has served in several large turbines for *over 20 years,* with no significant change in original characteristics! The Alchlor Process takes place *after* thorough refining of carefully selected crude oils—and removes unstable hydrocarbons that normal refining doesn't remove.

Gulfcrest is the world's finest turbine oil, incomparably stable. Your Gulf Sales Engineer will recommend the proper grade for you—just call the nearest Gulf office.

GULF OIL CORPORATION
GULF REFINING COMPANY
1822 Gulf Building
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BOILERS AND AUXILIARIES

1 **Boiler-burner units.** Illustrated 8-p bulletin ID-56-215 describes packaged firebox boiler-burner units engineered for 4-pass fire travel and automatic operation with oil or gas or oil-gas combinations. Available in 17 ratings from 35 to 485 hp. York-Shipley, Inc, York, Pa.

2 **Air-atomizing burner,** for burning low cost residual oil at low pressure, is described in illustrated bulletin AD-158. Burner is rated at 90 gph. Cleaver-Brooks Company, 326 E Keefe Ave, Milwaukee 12, Wis.

3 **Refractory materials.** Illustrated 8-p bulletin RB-20 covers 19 standard brands of refractory brick; lists classification, properties and applications of each brand. Richard C Remmey Sons Co, Hedley St and Delaware River, Philadelphia 37, Pa.

4 **Refractory castables,** both high-temperature service and light weight insulating types, are described in illustrated bulletin. Complete specs, tabular matter. Walsh Refractories Corporation, 101 Ferry St, St. Louis 7, Mo.

5 **Insulating firebrick** is subject of 8-p bulletin R-43. Contains photos, charts, tables, data on use of product in periodic kilns and salt-glazing kilns. The Babcock & Wilcox Company, 161 E 42nd St, New York 17, N. Y.

CONTROLS: ELECTRICAL, MECHANICAL

6 **Control operation** and application manual GEA-6372, 32 pp, describes manual, magnetic and reduced-voltage starters, pushbuttons, relays, limit switches, solenoids, pressure and vacuum, float, and plugging and anti-plugging switches. General Electric Company, Schenectady 5, N. Y.

7 **Time-delay relay** bulletin AWH TD403 contains details on function of three basic units, along with catalog part numbers for standard ranges and voltages in ac, dc and 400 cycle. The A W Haydon Company, Waterbury, Conn.

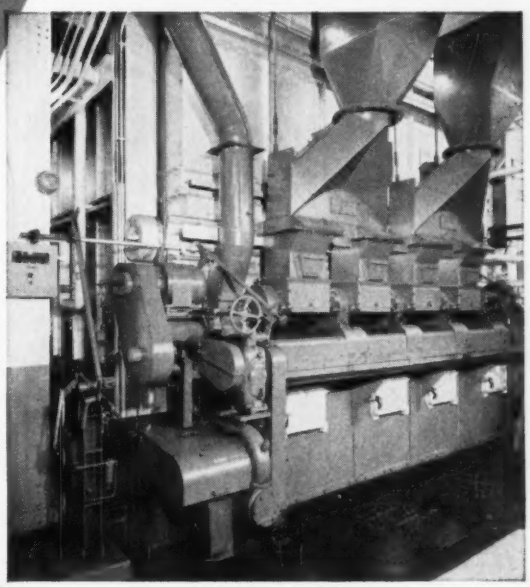
8 **Electrical positioning** controls for both push-button and automatic operation are covered in 8-p bulletin J-100. Features a shaft-mounted control gearmotor for valves and variable-speed drives to provide remote or automatic flow, speed, proportion and tension control. The Jordan Co, 3235 W Hampton Ave, Milwaukee 9, Wis.

9 **Temperature regulators,** vapor-pressure operated, are described in 4-p bulletin. Available in single-seat design for tight shutoff or double-seat design for continuous operation, both direct and reverse acting. Atlas Valve Co, 280 South St, Newark, N. J. (*Continued on p* 212)

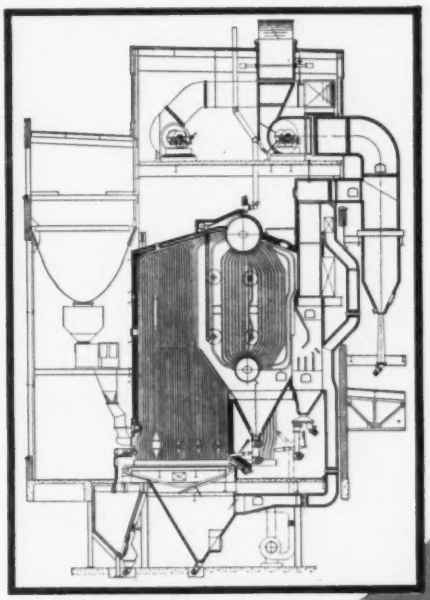
Detroit RotoGrate Stoker

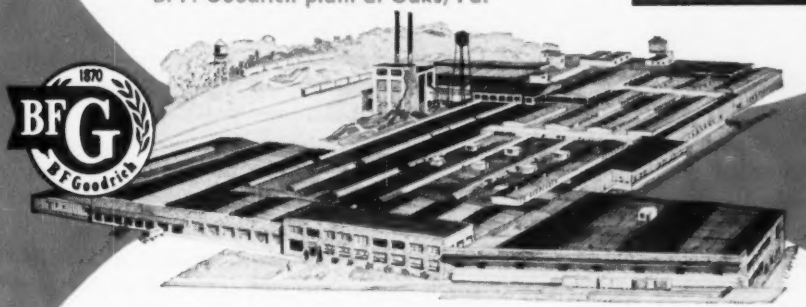
SELECTED FOR TIRE PLANT

The B. F. Goodrich Company, Oaks, Pa.



Detroit RotoGrate Stoker in
B. F. Goodrich plant at Oaks, Pa.





This Detroit RotoGrate Stoker is installed with a Wickes two drum Steam Generator, capacity 115,000 lbs. per hour at 300 psi and 440° F. Design is based on using 350° F preheated air, when burning Fairmont District West Virginia coal. This is part of an expansion program at this plant. Detroit RotoGrate is an advanced spreader stoker with specially designed overlapping grates that move slowly forward, discharging ash at the front. Any Bituminous coal or Lignite, and many types of refuse are successfully burned. High burning rates per square foot of grate and exceptional flexibility make this stoker popular. Detroit RotoGrate will save you money—improve your operation.

DETROIT STOKER COMPANY
GENERAL MOTORS BLDG.—DETROIT 2, MICH.
District Offices in Principal Cities • Works at Monroe, Mich.

DETROIT SINCE 1898 STOKERS

7106

George Edwards

advises, "Don't relive your mistakes"

► I ALWAYS LOOK FORWARD to my periodic visits to Baltimore, Maryland. One reason is my craving for the steamed crabs they have down there. I never seem to get my fill of them.

Big reason, though, is Buzz Crawford's machine shop. It's a regular idea factory.

Buzz, an old friend of mine, designs and builds specialized equipment. People come to him with a problem—or a whim—and Buzz generally comes up with a "widget" that'll do the job. He once equipped a wealthy woman's ebony-inlaid bridge table with a rig that would shuffle and deal the cards into a slot in front of each player. He still shakes his head when he thinks of that one.

Buzz never went to college, but he's one of those born machinists who has burned plenty of midnight oil to learn all he could about the theoretical angle of things.

He has four or five young designers working with him. They're all from engineering schools, but they're getting a real education from Buzz—and they love it. Together, they make quite a team and Buzz is proud as punch of them. In his own words he says "they keep me smart."

Walking into the shop a couple of weeks ago, I found Buzz and one of his boys down on their hunkers. On the floor was a geared shaft that was broken almost in two, about 16 inches from a large pinion on one end.

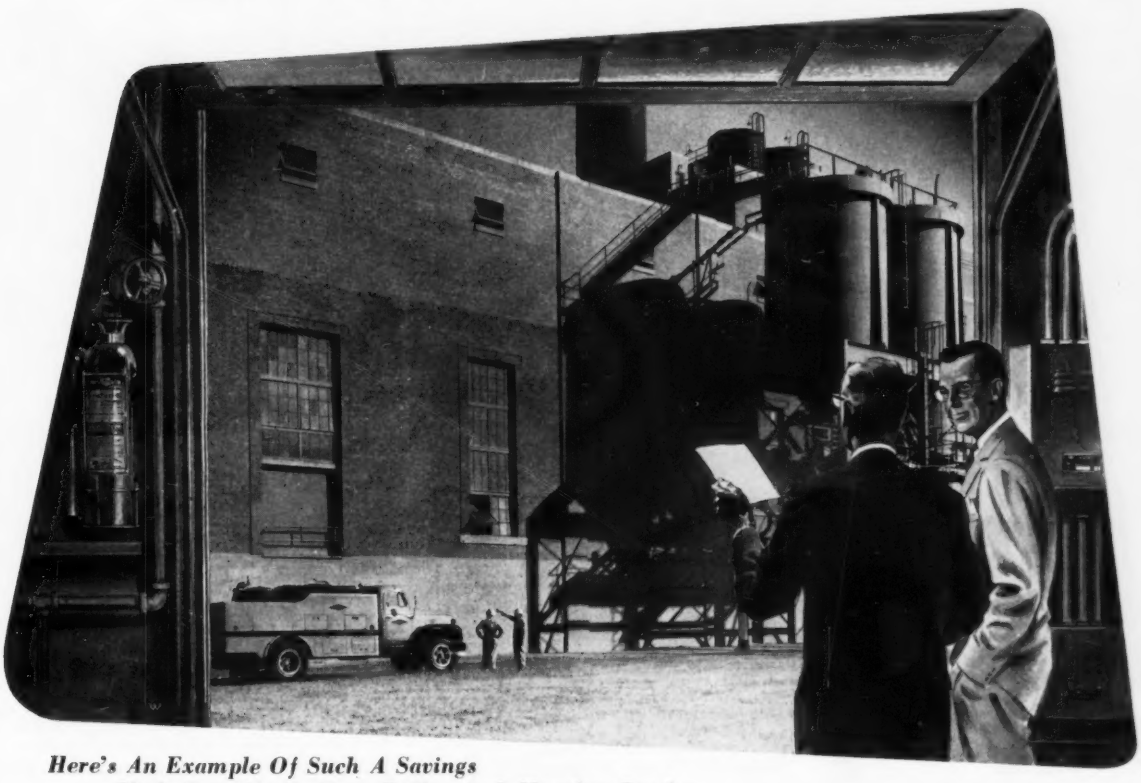
"Post-mortem," grinned Buzz as he stood up. "We've just found out why this baby let go. It's a little rough on the budget, but we're gonna regret it and forget it. Let's get a cup of coffee."

Later he told me the shaft was from a piece of equipment being developed for Air-Force use in the Arctic. It failed during a cold-room test run with the temperature down to about −70 F.

It was plain that it was a bitter pill for Buzz to swallow. But it was equally plain that he wasn't going to brood over it. He'd made a mistake and had been brutally honest with himself in finding out why. After that, there was to be no crying over spilled milk.

His philosophy of "regret it and forget it" says a lot in a few words. Being human, we'll make mistakes as long as we live. But having made one —and realizing it—we can benefit by the experience and go on from there. The self-torture of reliving past mistakes is as useless as trying to bring back yesterday.

how much could you add to your profit-- by saving $50,000 per boiler cleaning?



Here's An Example Of Such A Savings Made Possible By Dowell Chemical Cleaning Service

Dowell recently chemically cleaned a 1,000,000 lb. per hour steam generator for one of its customers. Total outage time was 48 hours. This saved the company an estimated five to seven days down-time, as compared to mechanical cleaning methods.

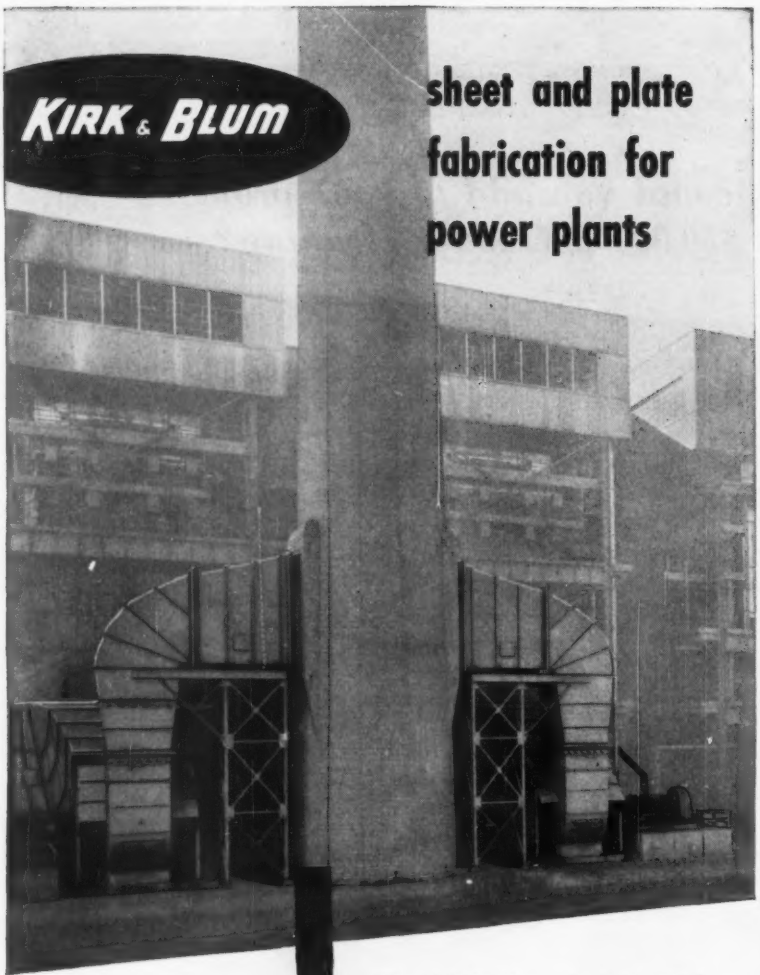
Considering replacement power for a boiler of this capacity costs between $7,000 and $15,000 per day, it's easy to see a $50,000 savings. And, it's just as easy to project a $250,000 to $500,000 annual savings for a plant with five to ten such boilers.

This particular case history concerns a power company with a forward-looking operations manager. But, Dowell has other startling performance data to show you — from your own industry. That's because chemical cleaning is so versatile. Dowell engineers are experts in removing scale and sludge from process systems, tanks and piping. They apply solvents in various ways— such as filling, jetting, cascading. Dowell furnishes all the necessary chemicals, trained personnel, pumping and control equipment.

For specific information on how chemical cleaning can help you to greater profits, call the Dowell office near you. Or write Dowell Incorporated, Tulsa 1, Oklahoma.

have Dowell clean it chemically **DOWELL**

A SUBSIDIARY OF THE DOW CHEMICAL COMPANY



- breechings
- stacks
- air & gas ducts
- casings
- louvers
- bins & hoppers
- insulation jacketing
- control panels & desks

The fabrication of sheet steel and plate to exacting specifications has been a specialty of Kirk & Blum for 50 years. Exceptional experience and complete facilities for fabricating carbon steel, stainless, aluminum, monel and other alloys up to ½" thickness.

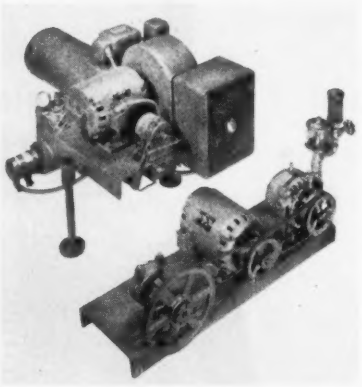
Send prints for prompt quotation or write for your copy of the latest Kirk & Blum Sheet and Plate Fabrication Booklet.

Whatever your requirements in sheet and plate fabrication . . . call on KIRK & BLUM.

THE KIRK & BLUM MFG. CO.
3233 Forrer Street, Cincinnati 9, Ohio

More EQUIPMENT NEWS

Begins on page 162



Economy oil burner

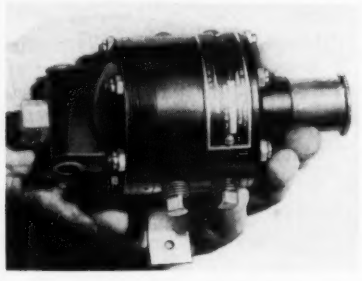
132 • Higher efficiency from low-cost No. 5 fuel is said to be a feature of *TH-60* and *TH-84* oil burners. A 2000-watt preheater heats oil to burning temperature. Manufacturer claims that a saving up to 30% in fuel cost may be effected. Nos. 1, 2 and 4 oils may also be burned.

Other features are: (1) iris shutter to provide accurate, metered air control (2) built-in viscosity compensator to assure constant firing rate regardless of oil viscosity (3) improved air-oil atomizing nozzle. Unit also has a low-fire start, which assures safe ignition without flarebacks because flame starts at small size.

Compressor, fuel-oil pump and motor are located on a separate chassis, which may be installed on a wall or suspended from the ceiling. Request details from maker.

York-Shipley, Inc,
75 Jessop Place, York, Pa.

For more details on these items, use post cards p 171. Identify your request with item number.

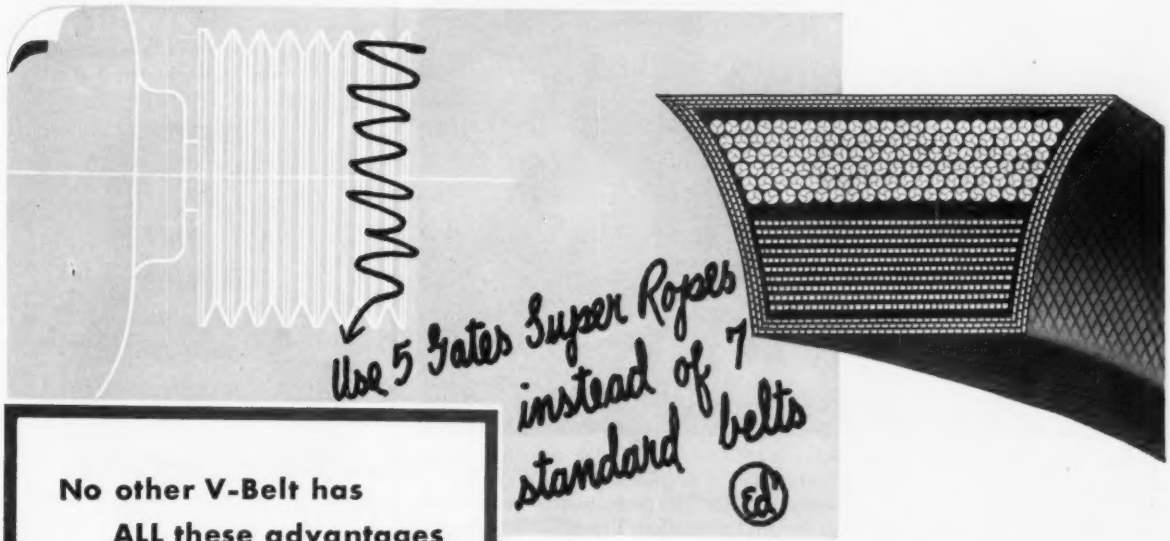


Differential transmitter

121 • Hitherto unchecked sources of steam, water and air in departmental consumption can be easily and economically cost-accounted with fixed range differential transmitter, according to manufacturer.

Unit measures 6½x3 in.; weighs 4½ lb; can be pipe mounted; all connections ¼ in. internal NPT. A wrench and screwdriver can install and adjust it on stream for zero. Diaphragm is neoprene-impregnated nylon. Body material is brass. Maximum working pressure: 150 psi; tempera-

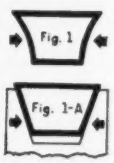
Get more HP delivered per $ of drive cost



No other V-Belt has ALL these advantages

1. Tough, resilient Tensile Cords

Super-strength tensile cords provide 40% greater horsepower capacity . . . easily absorb heavy shock loads . . . reduce number of belts required . . . save weight and space.



2. Concave Sidewalls (U.S. Pat. 1813698)

Concave sides (Fig. 1) increase belt life. As belt bends, concave sidewalls become straight, making uniform contact with sheave groove (Fig. 1-A). Uniform contact means less wear on sides of belt . . . far longer belt life.

3. Flex-Weave Cover (U.S. Pat. 2519590)

A Gates exclusive provides greater flexibility with far less stress on fabric. Cover wears longer . . . increases belt life . . . more power available to driven machine.

4. High Electrical Conductivity

Built into Gates Super Vulco Ropes for safer drives (in explosive atmospheres).

5. Oil, Heat, Weather Resistant

Special rubber compounds make Super Vulco Ropes highly resistant to heat, oil, and prolonged exposure.

Cut sheave width and weight with Gates Super Vulco Ropes

You save on cost of iron . . . you reduce bearing width and support . . . you save space and overall cost . . . when you design a drive using Gates Super Vulco Ropes. Here's why:

5 Gates Super Vulco Ropes do the work of 7 standard V-belts

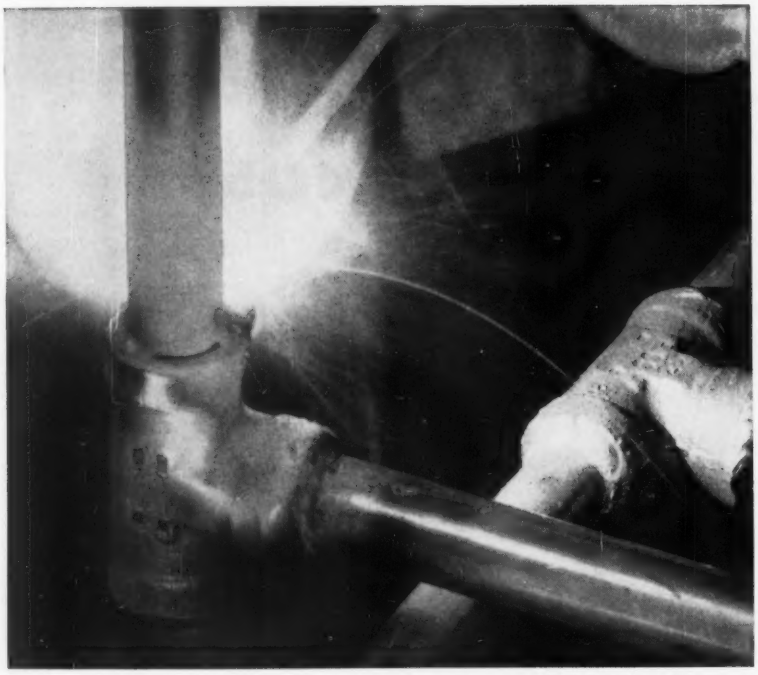
That's because Gates Super V-Belt has 40% more horsepower capacity than standard belts. Therefore, you can reduce sheave width and weight . . . cut cost.

A wealth of drive data is quickly available to you. Simply call your nearby Gates V-Belt Distributor (see 'phone book yellow pages) for a Gates V-Belt specialist. Stocks available in industrial centers around the world. The Gates Rubber Co., Denver, Colorado—*World's Largest Maker of V-Belts.*

The Mark of Gates Specialized Research

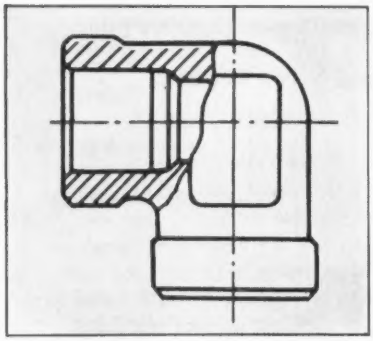
TPA 91

Gates Super VULCO ROPE Drives

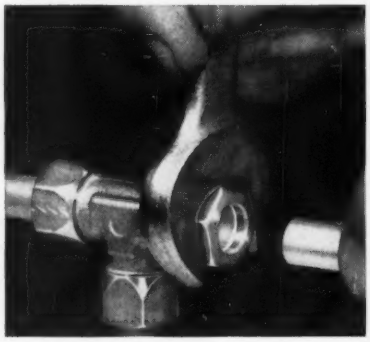


Simply insert tube, then weld! No wonder Parker Weld-lok *tube* fittings are so easy to use . . . by anyone, anywhere. You don't need special gripping fixtures. A tapered socket aligns and holds the tube. The permanently welded joint is unaffected by vibration, shock, or thermal distortion. Especially good under extreme temperature or corrosion conditions.

Use Parker Weld-lok fittings for tubing ¼ through 2" O.D.



Cutaway view of Weld-lok *tube* fitting shows detail of the simple design. All commonly used connectors and body shapes are offered in steel and stainless steel. Send for Catalog 4370 listing shapes, sizes.



Intru-lok fittings are easy to use for copper instrumentation lines. Just insert the tube, then tighten the nut with a regular wrench . . . for a leakproof vibration-proof joint. Also used with plastic tubing. Send for Catalog 4324.

TUBE AND HOSE FITTINGS DIVISION
Section 424-X
The Parker Appliance Company, 17325 Euclid Ave., Cleveland 12, Ohio

Parker
Hydraulic and fluid system components

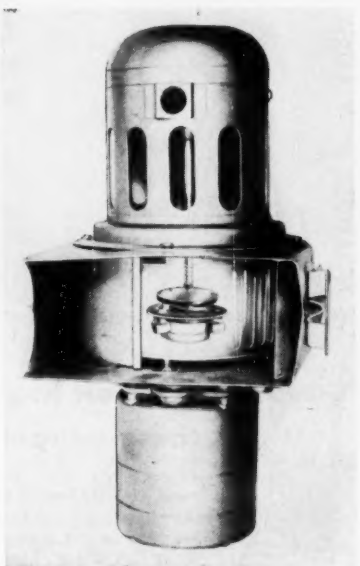
More EQUIPMENT NEWS

Begins on page 162

ture: 150 F. Air supply pressure is 20 psi. Air consumption is 0.10 standard cfm. Output pressure range is 3 to 15 psi.

Calibration accuracy is better than 1%, according to manufacturer. Sensitivity exceeds 0.1%. Ranges: 0 to 50, 100, 200 and 300 in. of water. May be mounted indoors or outdoors.

Taylor Instrument Companies, 95 Ames St, Rochester, N. Y.



Centrifugal switch

137 • Unit protects gas furnace burner against blower failure. If blower speed falls below normal, switch actuates controls which immediately shut off gas flow.

Switch is mounted on blower shaft and operates in conjunction with a mercury switch assembly. According to manufacturer, switch operates on frictionless, snap-action principle that eliminates all wear associated with fly-ball-spring-pivot governors. It is also claimed that switch provides a uniformly operating life in excess of 1,000,000 cycles.

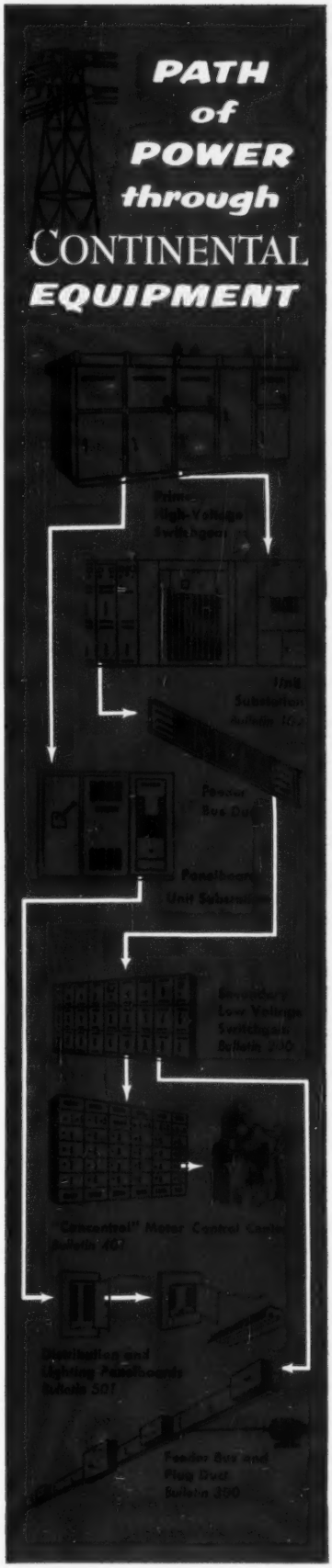
Torq Engineered Products Co, Interstate St, Bedford, Ohio

For more details on these items, use post cards p 171. Identify your request with item number.

Molybdenum disulfide compound

141 • Line of molybdenum disulfide compounds are designed specifically to help solve industry's tough lubrication problems.

Each product in the line is developed with a particular industry in mind, but, according to manufacturer, its applications are not limited to one field. As an example, one such product incorporating moly in a volatile base, is applied in the same manner as a light viscosity lubricant. Moly is conveyed to points to be protected where

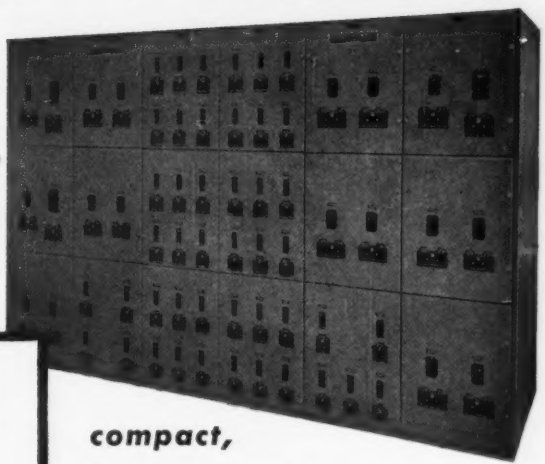


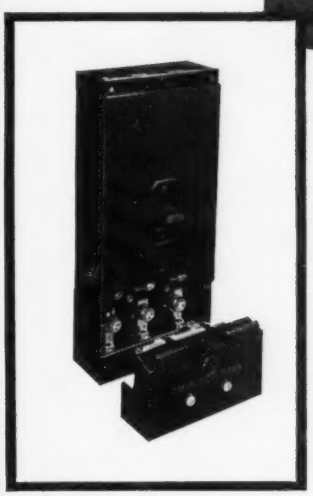
CONTINENTAL Low Voltage

DRAWOUT SWITCHGEAR

featuring

NEW "CORDON" Current Limiting Circuit Breakers





New draw-out "Amp-Trap", unusually compact current limiting fuse, makes combination breaker feasible.

compact, low cost units with 100,000 amp interrupting rating

This CONTINENTAL Low Voltage Switchgear offers attractive initial cost . . . plus a new protective device that solves high magnitude low-voltage short circuit current problem.

"Cordon" current limiting Circuit Breakers provide protection to 100,000 amp. rms interrupting rating, yet save you money. Add this important feature to the safety and economy of rigid, compact CONTINENTAL switchgear . . . the result is low cost, low maintenance equipment protecting you better than ever.

Compare for yourself. Write for detailed specifications today.

DELIVERY: 6 WEEKS*

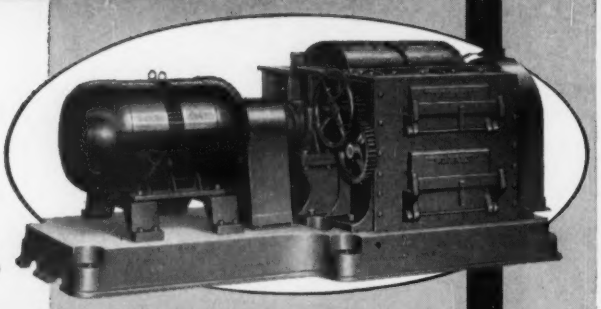
CONTINENTAL

ELECTRIC EQUIPMENT CO.

221 West 4th Street Cincinnati 2, Ohio

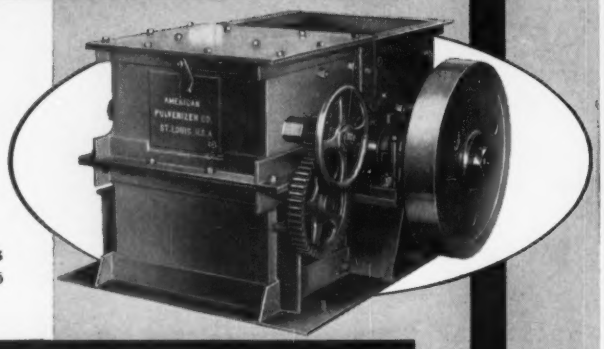
*Standardized units only, not requiring approval drawings. If approval drawings are required, add 2 weeks.

When You Figure . . .



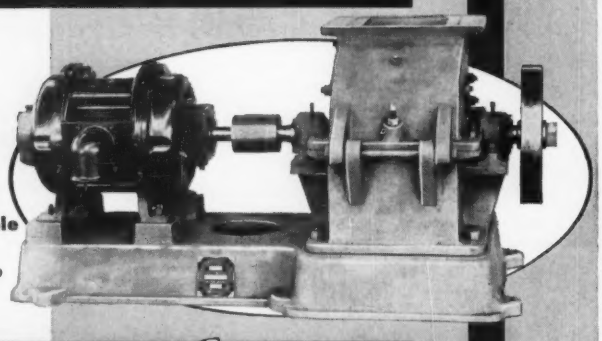
AC Series
capacities to
800 TPH

Reduction
Cost Per Ton . . .



WC Series
capacities to
90 TPH

the Best Answers*. . .



Coal Sample Crushers
capacities to
2000 Lbs.
Per Hr.

Come from *American*
Ring Coal Crushers

*In a recent independent survey, it was found that American Crushers reduced over 61,000,000 tons of coal at a parts replacement cost (including standby parts) of *less than 1/10th of 1¢ per ton.*

THERE CAN BE NO BETTER PROOF OF AMERICAN QUALITY!

American
PULVERIZER COMPANY

WRITE for Literature on These Crushers

Originators and Manufacturers of Ring Crushers and Pulverizers

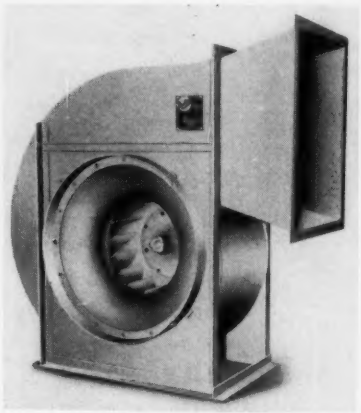
1349 MACKLIND AVE. • ST. LOUIS 10, MO.

More EQUIPMENT NEWS

Begins on page 162

it volatizes, leaving moly to function as a dry lubricant. Originally developed for use in the food and textile industries, it is said to have infinite applications in the power field.

VanGuarD Solid Lubricants, Inc,
57 E 73rd St, New York 21, N. Y.

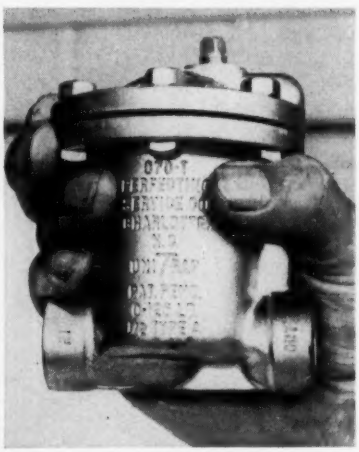


Radial wheel fan

123 • Radial blade fan has high-volume, high-pressure characteristics that make lower first cost possible on many applications. *Type CR* fan offers high mechanical efficiency—above 78%—over a broad range, and is also highly suitable for handling dust-laden air. These characteristics are said to be result of inlet-to-outlet streamlining and radial blade design.

Buffalo Forge Company,
465 Broadway, Buffalo, N. Y.

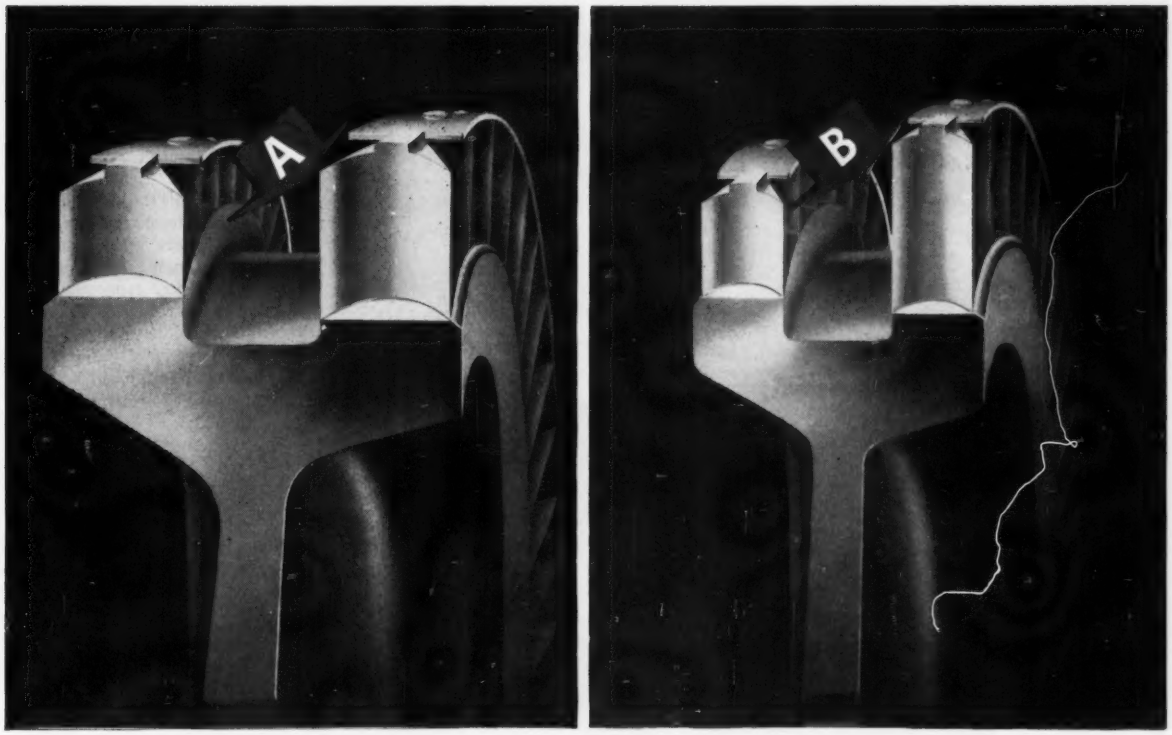
For more details on these items, use post cards p 171. Identify your request with item number.



Universal steam trap

124 • Small, lightweight bucket-type steam trap for unit heaters, small processing machinery and like applications is available in ½-in. pipe size with a universal pressure range from 0 to 125 psi.

Trap operates on a balanced pressure



(Left, A) wide bucket "L" type wheel. (Right, B) regular type wheel for Coppus Steam Turbines

Now...for low steam consumption – **COPPUS TURBINES** *can be furnished with wide bucket "L" type wheel*

Good news for steam turbine users where low steam consumption is important!

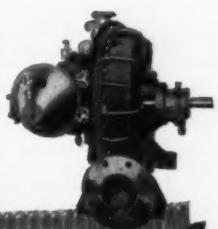
The Coppus Type "L" Wheel is the answer to this problem. Larger turbine buckets are employed to make the most economical use of steam.

In every respect the Coppus Turbine offers the top-quality features and advantages that have made the Coppus line outstanding for efficiency and economy. For example:

- Turbines rated close to your exact hp requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.

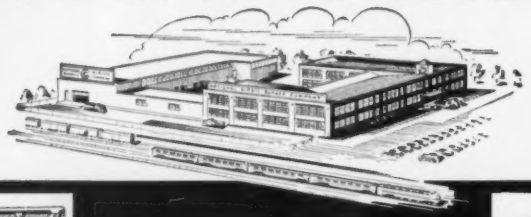
Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, *make turbine dollars go farther.* Send for Bulletin 135 on Coppus Turbine.

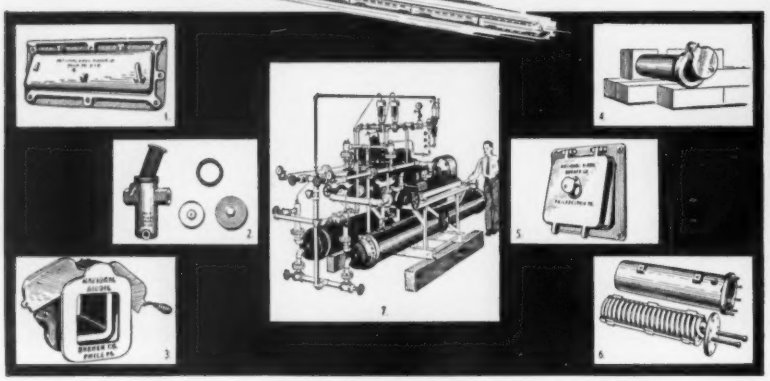
COPPUS ENGINEERING CORPORATION
161 Park Avenue
Worcester 2, Mass.
Sales offices in
THOMAS' REGISTER



COPPUS "BLUE RIBBON" TURBINES

A Complete Line of
COMBUSTION ACCESSORIES





for EVERY
INDUSTRIAL LIQUID FUEL-GAS INSTALLATION

1. Air Control Door and Frame, top hinged, ratchet type, heavy duty, for manual control. Surfaces are machined to a close fit.
2. Fuel Oil Suction Strainer, single type. Large basket area insures low pressure drop; cover and basket easily removed for cleaning.
3. Wide-View Peephole, safety, curtain type. Cobalt glass removed to show bearing surface for curtain. Curtain halves are interlocked—open simultaneously.
4. Ignition Port with Refractory Tile No. M896 . . . for use with standard 3" pipe. Also serves as a peephole.
5. Furnace Relief and Access Door, heavy construction, practically air tight. Door casting correctly weighted, lined with plastic refractory retained by imbedded grill; with observation port and cover.
6. Fuel Oil Heater, Self-Cleaning, Spiral Coil type. High oil velocity in coil, resultant turbulence prevents carbon formation. No internal connections or joints.
7. Fuel Oil Pumping and Heating Unit . . . Twin or Single Pumps, Steam driven, Electric driven or combination Steam-Electric, with Single or Double Fuel Oil Heaters and accessories for feeding oil at constant pressure and temperature.

. . . yes, just as we are proud of supplying the *right* liquid fuel or gas burning equipment (over 40 years experience throughout industry), so, also, are we proud of our full line of highest quality accessories to supplement your every combustion need. Within our modern, "daylight" factory, salesrooms and general offices NATIONAL AIROIL likes and adheres to the phrase, "nothing but the best"! We believe that our record speaks for itself . . . i.e.; the "right combination" for you in achieving maximum combustion economy is: NATIONAL AIROIL Fuel Oil, Gas or Combination Oil and Gas Burning Equipment; NATIONAL AIROIL Combustion Accessories; and, NATIONAL AIROIL Engineering Consultation.

May we be of help to you in accomplishing your particular installation or in solving that difficult problem?

Established 1912 — Incorporated 1917

CHEMICAL-PETROLEUM DIVISION

NATIONAL AIROIL BURNER CO., INC.

1250 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.
Southwestern Division: 2512 South Boulevard, Houston 6, Texas
INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

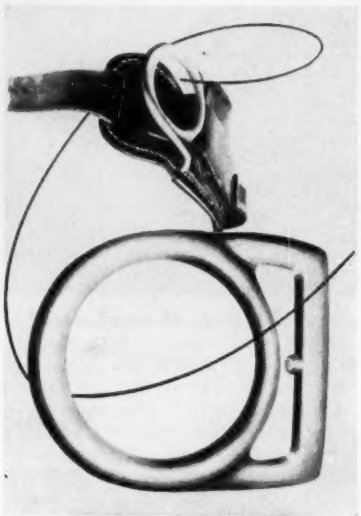
More EQUIPMENT NEWS

Begins on page 162

principle through function of a dual-valve which automatically compensates for differential pressures through a range of 0 to 250 psi.

Dual valve permits trap to operate through fluctuating steam pressures and variable condensate rates within range of the traps without changing orifice size or bucket weights. Discharge capacities range from 3500 lb per hour in the ½ in. to 55,000 lb per hour in the 1½ and 2 in. traps.

Perfecting Service Co,
332 Atando Ave, Charlotte, N. C.



Adaptable dee ring

126 • Dee ring is functional in design, adaptable to any style belt and requires no special application or different technique to use.

According to manufacturer, design makes it impossible for snap to get underneath waist strap, thereby eliminating snap roll-out hazard. In addition to safety features, angle is said to be more comfortable, relieving body pressure where dee plate is fastened to belt because it holds safety strap in more normal relation to pole.

Miller Equipment Co, Inc,
1 New St, Franklin, Pa.

For more details on these items, use post cards p 171. Identify your request with item number.

Evaporation barriers

117 • Evaporation barriers are specifically designed for vapor retardation by as much as 75%

Barriers are, in essence, expanded polyethylene miniature floats containing thousands of tiny air cells for buoyancy and light weight. They exhibit chemical and solvent resistance of polyethylene, and, according to manufacturer, cannot be punctured or broken in roughest use.

Specifically engineered surface contours

Unretouched photo showing typical return line corrosive action resulting from carbonic acid and dissolved oxygen in condensate.

BREAKING DOWN WITHIN

This section of pipe looks like new—on the outside. But take a look inside. Grooving action caused by carbonic acid and deep pitting, the result of dissolved oxygen attack, have almost completely penetrated the pipe wall.

Dearborn FILMEEN* prevents such destruction. FILMEEN forms a protective, non-wettable barrier between treated steam, or condensate, and metal pipe surfaces. By preventing the carbonic acid and dissolved oxygen from coming into contact with the metal, FILMEEN assures corrosion-free lines. FILMEEN is only one of many Dearborn water conditioning products scientifically developed to control specific corrosion problems. Others eliminate scale, sludge, carry-over and similar difficulties.

Power engineers in leading industrial and commercial plants place their confidence in Dearborn's 70 years of experience in water chemistry. They have found the answer to the demand for complete plant protection in Dearborn Supervisory Service—a properly balanced water conditioning program which combines quality products with correct, technically supervised control methods and test procedures.

Let a Dearborn Engineer survey your plant and recommend the type of water control program best suited to your requirements.

**FILMEEN is the trade-mark of a corrosion-inhibiting compound patented and produced exclusively by Dearborn Chemical Company. U.S. Pat. No. RE 23614.*

Dearborn®

...a leader in water conditioning and corrosion control for 70 years

Dearborn Chemical Company
Merchandise Mart Plaza, Dept. PO Chicago 54, Ill.

Gentlemen: ☐ Have a Dearborn Water Conditioning Engineer call.
☐ Send me complete information on Dearborn Water Conditioning Program.

Name.....*Title*.....

Company.....

Address.....

City.....*Zone*.....*State*.....

BELMONT

BEL-VEE

The "Pressure-Sealing" V-Ring Packing

SEATS AUTOMATICALLY

•

KEEPS EQUIPMENT RUNNING SMOOTHLY. CUTS MAINTENANCE

•

BASIC MATERIAL COMBINATIONS FOR VARIOUS SERVICES

•

A SIZE FOR EVERY ROD & STUFFING BOX

Scientifically designed to make the pressure seal itself, BEL-VEE Rings expand toward the rod and stuffing box wall, on the power stroke or with increased pressure, to automatically form the pressure seal.

On the return stroke, or with pressure relaxed, BEL-VEE Rings contract from the rod for free movement with minimum friction.

BEL-VEE Rings are individually molded in a number of basic material combinations. Offered in sets for pressures to 6000 psi. for sealing reciprocating rods of pumps, engines, compressors, hydraulic equipment and valve stems—handling water, oil, solvents, steam, air and gas.

BEL-VEE Rings are made in practically every rod and stuffing box size.

Ask your BELMONT *Packing Distributor or write for catalog.*

THE BELMONT PACKING & RUBBER COMPANY

Butler & Sepviva Streets
Philadelphia 37, Pennsylvania

BELMONT

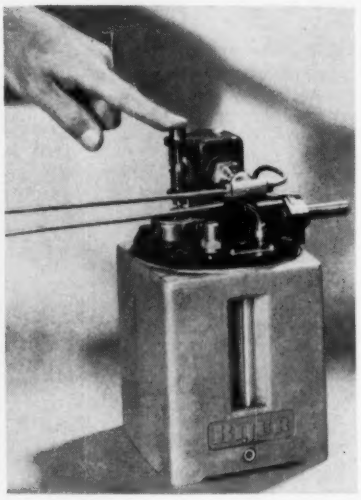
More EQUIPMENT NEWS

Begins on page 162

provide for extensive interlocking and clustering at the surface of volatile solutions.

Technical data: bulk density—17 lb per cut ft; material density—35 lb per cu ft equals .60 density; number of barriers per lb—240 or 480 per cu ft; nominal dimensions—¼ in. thick by 1½ in. max width.

American Agile Corp, 5461 Dunham Rd, Maple Hghts, Ohio



Duplex lubricator

118 • Two independent lubrication systems, providing both cyclic and continuous oil flow to different bearings on same machine are built into single automatic lubricator.

Lubricator is designed specifically for machines with dual lubrication problem, where some bearings need periodic lubrication, others require oil continuously.

Unit consists of two independent gear pumps with common drive gear, mounted in single housing, both drawing oil from a common reservoir in bottom of the housing. Each pump has its own inlet (from reservoir) and outlet (to distribution line), feeding oil through separate distribution systems to bearings each serves. At each lubrication point in the distribution systems a meter-unit filters and measures exact quantities of oil fed to each bearing.

Bijur Lubricating Corp, 151 W Passaic St, Rochelle Park, N. J.

For more details on these items, use post cards p 171. Identify your request with item number.

Adjustment sheaves

129 • One and two-groove sheaves, for speed adjustment of V-belts, are designed for low horsepower applications. Manufacturer claims that sheave provides for maximum design horsepower.

Keys transmit all rotational torque from shaft to hub and hub to disks. It is said that set screws no longer bite into threads. Flexible-joined set screw and key give

from track hopper

to silos to bunkers...

from ash pit to the dump,

JEFFREY mechanizes every move!

For many years, Jeffrey coal and ash handling equipment has been safeguarding service in many of the country's power plants. And showing a remarkably low cost-per-ton of coal handled. Jeffrey makes equipment for every type and size of plant.

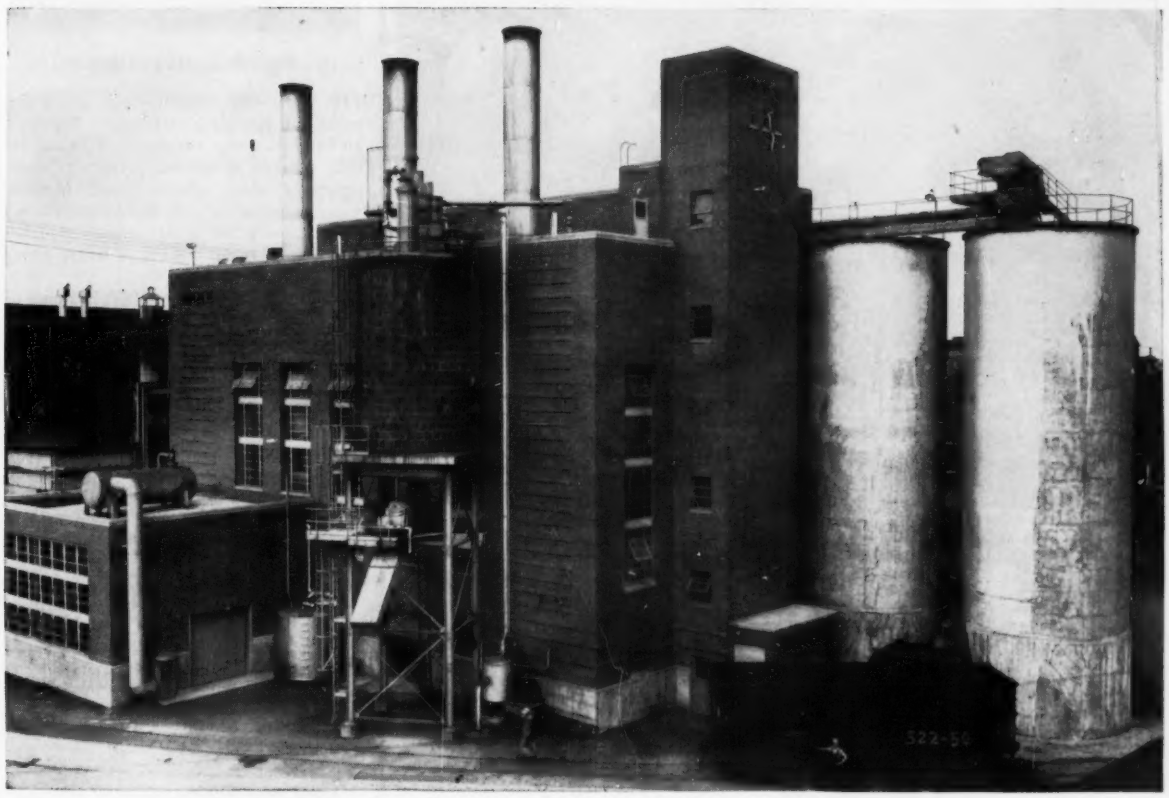
TRACK HOPPERS—in many shapes and sizes; 5 tons to 30.

FEEDERS—spiral, plate, electric vibrating and apron feeders; a type to meet any local condition.

CRUSHERS—reduce lump coal to uniform sizes in a single operation, assuring maximum stoker efficiency.

BUCKET ELEVATORS—for elevating and distributing coal; in various heights and in capacities of 25 tons to 40 tons per hour. Also V-bucket elevator-conveyors and pivoted bucket carriers. Scraper and drag chain conveyors for inclined and horizontal runs.

SPIRAL CONVEYORS—ideal for use in limited space and where demands are moderate. Coal can be discharged at any point through valves in trough bottom. Available in various lengths.

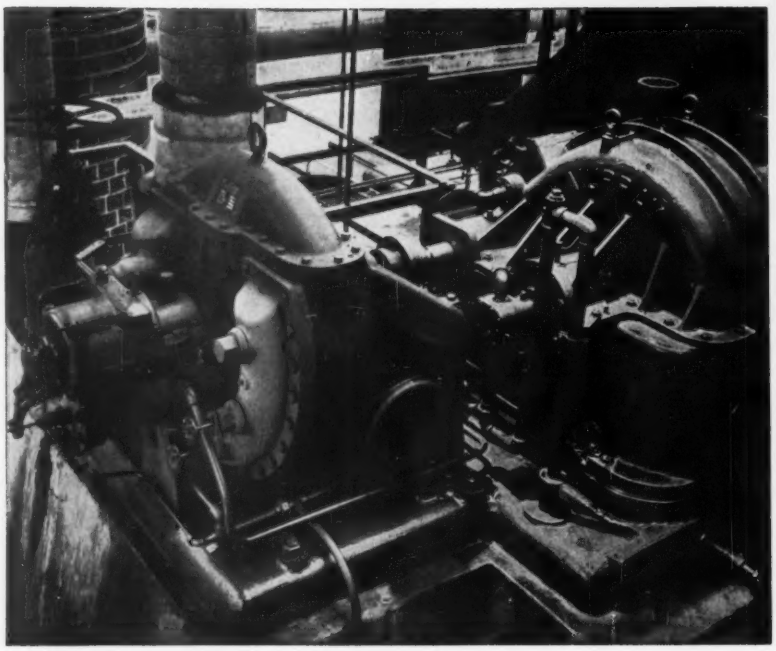


Jeffrey engineers will assist you in selecting the most efficient and economical Jeffrey coal and ash handling equipment to meet your requirements. Literature is available on each of these product groups. The Jeffrey Manufacturing Company, Columbus 16, Ohio.

JEFFREY

CONVEYING • PROCESSING • MINING EQUIPMENT • TRANSMISSION MACHINERY • CONTRACT MANUFACTURING

Murray Turbines



One of 4 Murray type U turbo-gear units installed in a southwest rubber plant still giving trouble free service after 12 years in an unprotected outdoor location. This unit drives an Induced Draft Fan requiring 425 HP at 683 RPM. The turbine speed is 3500 RPM.

• Murray turbo-gear units for mechanical drive are right at home in difficult outdoor installations. Fans, pumps, compressors, and many special types of slow speed machines are among the long list of installations powered by Murray turbo-gear units.
Murray gears are of the Herringbone or Double Helical type and all are pressure lubricated at the point of tooth contact.

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

More EQUIPMENT NEWS

Begins on page 162

positive lock between movable disk and stationary hub. Manufacturer claims that key and set screw cannot drop out during adjustment nor move out of alignment.

Allis-Chalmers Mfg Co,
952 S 70th St, Milwaukee, Wis.

Portable pH recorder

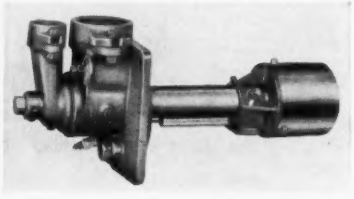
119 • Portable, self-contained, pH measuring and recording instruments requiring no external power supply are designed for field surveys of stream pollution, waste-treatment plant effluent, and industrial water supplies, as well as in-plant studies at locations where a permanently mounted pH recorder is not desired, or where power is not available.

Equipment will cover total pH range of 0-14 in two partial ranges of 0-8 and 6-14. Selection is by means of a switch located on amplifier. Chart drive can be set to rotate chart in either one hour or 24 hours.

Two units weigh less than 50 lb. Temperature compensation is by means of a manual adjustment, after reading temperature of liquid being tested. Various types of electrodes are available, including those for immersion, flow and laboratory applications.

The Bristol Co,
117 Bristol Rd, Waterbury, Conn.

For more details on these items, use post cards p 171. Identify your request with item number.



Gas burners for tube firing

133 • *Series RTG* burners are designed to provide control of flame length to fit length of radiant tubes and give better

STANOLITH Grease gives coal a smooth ride

Over 5,000 bearings need just one grease. Never a bearing lubrication failure.

Part of the coal for the Wabash River Generating Station operated by the Public Service Co. of Indiana near Terre Haute, comes directly from the Viking Coal Mine Processing Plant via a conveyor system. The system operates 365 days a year moving up to 4,800 tons of coal per day. STANOLITH Grease has been used to lubricate all bearings in the conveyor system since February 3, 1953, the start up day. In all that time there has never been a bearing lubrication failure.

Prior to the initial operation of the conveyor system, maintenance supervisors checked with Paul Manning, Standard Oil industrial lubrication specialist, about lubricating the new installation. Paul, they knew, has extensive experience (21 years) in handling lubrication problems of this kind. Working with plant management, Paul recommended STANOLITH Grease No. 42 for the job. STANOLITH Grease has fulfilled maximum expectations.

STANOLITH Grease is a smooth textured grease. It is made from highest quality oil, lithium soap and special additives. It resists water washing and water contamination. STANOLITH Grease works well in exposed, outdoor installations. It will not channel. It is chemically stable. It can be applied easily by hand, gun or pressure system.

Find out more about STANOLITH Grease. Talk to your Standard Oil industrial lubrication specialist. There is one near you in any of the 15 Midwest or Rocky Mountain states. Or write 910 South Michigan Avenue, Chicago 80, Illinois.

***Quick facts about* STANOLITH Grease**

- Water resistant
- High temperature resistant
- Pumpable in grease gun or pressure system
- Mechanically stable

STANDARD

STANDARD OIL COMPANY
(Indiana)

Part of coal conveyor system at Wabash Power Plant, Terre Haute. Entire conveyor is lubricated with one grease —STANOLITH. No bearing failures experienced during the 3½ years conveyor has operated.

BIDDLE *Instrument News*

FRAHM® FREQUENCY MONITOR

. . . for opening or closing an electrical contact when the frequency of the power line to which the monitor is connected reaches a preset limit. The monitor can be furnished for low or for high limit operation.

TYPICAL APPLICATIONS

. . . In power transmission systems as a low frequency alarm with manual reset to call for load shedding or other corrective action to bring system frequency back to normal.

. . . For generators as low and high frequency alarm and, under certain conditions, as simple "on-off" frequency controller which can keep frequency between preset low and high limit.

. . . For turbines and other machinery with parts rotating at high speed as overspeed alarm and limiter when used in conjunction with an electric tachometer generator.

Write for **PRICES** and **BULLETIN 33-06-P**

Biddle Motor and Phase Rotation Tester *(Dual Purpose)*

With it you can . . .

- **Determine the direction of rotation of electric motors before they are connected to the line.**
- **Determine the phase rotation or sequence of energized power circuits.**

Here is a positive means for determining which motor leads must be connected to certain conductors of a supply system to insure that the motor will rotate in a prescribed direction when energized.

This device will permit the electrical contractor or industrial maintenance electrician to permanently connect and tape the terminals of the motor being installed, without having to first energize the motor by a temporary "hook-up" from a power source, if available, to determine its rotation.

Housed in a sturdy oak case 12¼" x 8¼" x 4¼" this compact unit weighs approximately 10 pounds and is supplied complete with 3 line and 3 motor leads which store in the compartments either side of the instrument panel.

For complete details write for **BULLETIN 80-P**

8623

JAMES G. BIDDLE CO.

- ELECTRICAL TESTING INSTRUMENTS
- SPEED MEASURING INSTRUMENTS
- LABORATORY & SCIENTIFIC EQUIPMENT

1316 ARCH STREET
PHILADELPHIA 7, PA.

More EQUIPMENT NEWS

Begins on page 162

heat distribution. Primary-air adjustment feature permits burner application to a full range of tube sizes.

According to manufacturer, burner operates more quietly because major portion of combustion air is introduced around outside of flame retention nozzle. Diverted air flow helps prolong combustion over a greater length to get best heat distribution. All combustion air is supplied through sealed-in burner, eliminating need for an eductor or exhaust fan. Burner permits turn-down ratio of 5 or 10 to 1. Unit may be operated with automatic control of on-off, high-low or modulating type.

Hauck Mfg Co, 124-36 10th St, Brooklyn 15, N. Y.

Electric rotary hammer

122 • Portable electric rotary hammer. Creates over 36,000 shock waves a minute, cuts a clean, true hole up to 40 ft in depth through the hardest stone, rock or reinforced concrete, according to manufacturer. Weighs approximately 10 lb. Requires no pressure. Unit features a high-speed water and air swivel, and is designed for drilling 3/16 up to 1½ in. diameter in concrete or masonry for steel pipes, slug-ins and electrical installations.

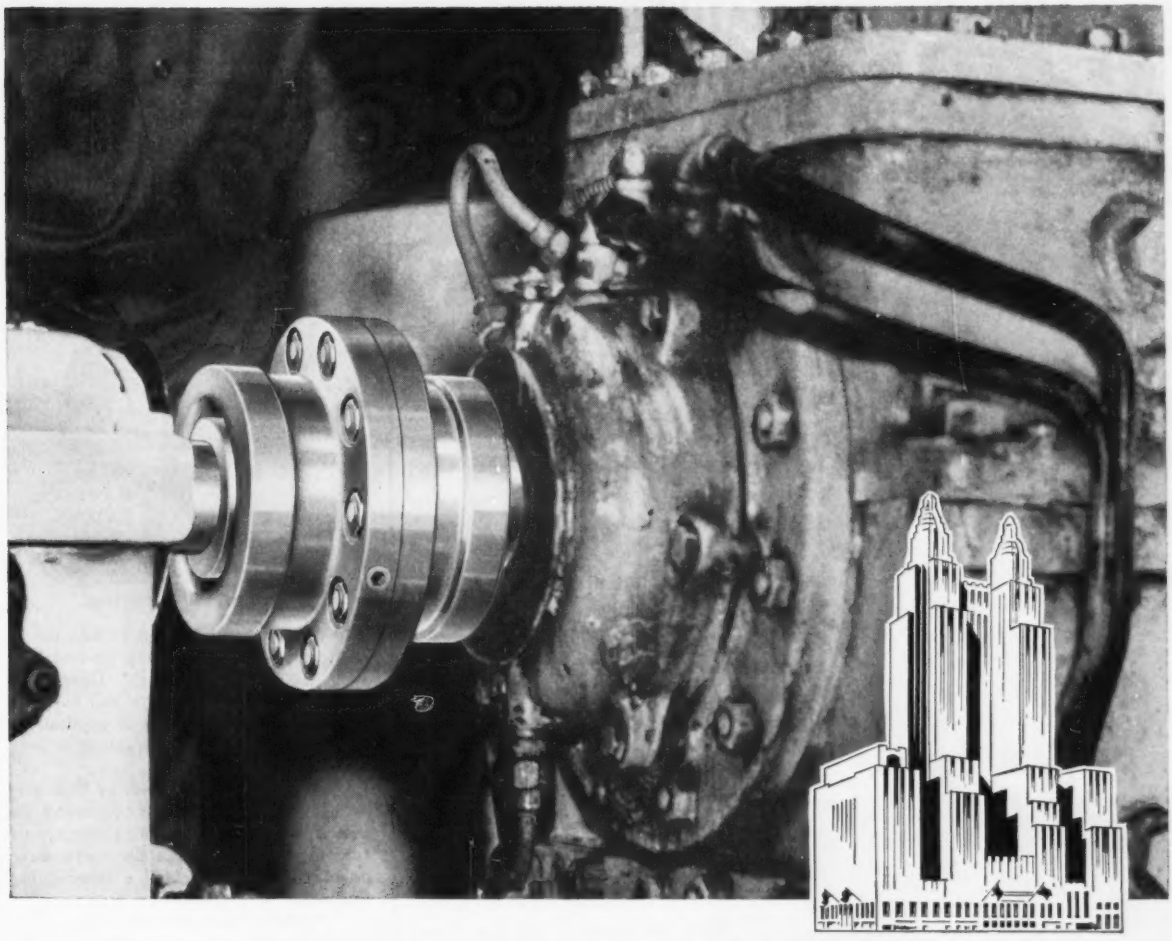
Demo-Haines Tool Corp, N 10th Machine Works, Enid, Oklahoma

For more details on these items, use post cards p 171. Identify your request with item number.

Mechanical load meter

120 • Unit measures any mechanical load, force or thrust. Converts mechanical force to proportional hydraulic pressure, through use of diaphragm-type assembly.

Pressure is indicated on test gage, which is specially recalibrated to read directly in mechanical force. Different models are offered with different size diaphragms and related parts. Thus, very heavy loads may



Fast's Couplings give Waldorf-Astoria 25 years of trouble-free service!

In 1930, Waldorf-Astoria management introduced air-conditioning in the hotel with the installation of a 240-ton centrifugal compressor. Five years later, two 350-ton compressors were added. All three machines were equipped with Fast's Couplings. To this date, those couplings have required no repairs of any kind.

For Fast's, the *original gear type* couplings, trouble-free performance is an old story. Because of their rugged all-steel construction and unique design, Fast's Couplings many times outlast the equipment they connect. This means you save on maintenance. You save on costly down-time. And throughout the years you can count on Fast's to provide reliable high torque transmission and protect your equipment against misalignment.

Over 35 years of coupling experience qualify Koppers' staff to give you the most effective and cost-saving solutions to *your* coupling problems. For free catalog, mail coupon below to: KOPPERS COMPANY, INC., Fast's Coupling Department, 3301 Scott St., Baltimore 3, Maryland.

THE ORIGINAL **FAST'S Couplings**

KOPPERS

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE, MD. This Koppers Division also supplies industry with American Hammered Industrial Piston and Sealing Rings, Koppers Electrostatic Precipitators, Aeromaster Fans and Gas Apparatus. ***Engineered* Products Sold with *Service***

KOPPERS COMPANY, INC., *Fast's Coupling Dept.,* **3301 Scott St., Baltimore 3, Md.**
Gentlemen: Please send me FREE Fast's Catalog giving detailed descriptions, engineering drawings, capacity tables and photographs.

Name.....

Company.....

Address.....

City.....Zone.....State.....

CONSTRUCTION FEATURES ---

PLUS CONTROLLED QUALITY

make Your Choice of the

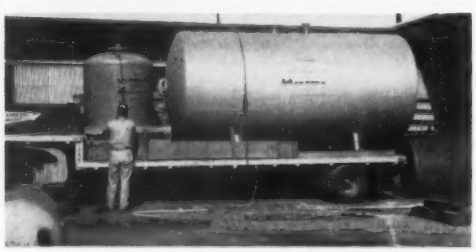
L★A Deaerator

a Wise One indeed!

- Always completely assembled in our own shop
- Always fabricated by our own skilled employees
- Constantly supervised by our own engineers
- Fabricated of highest quality materials
- API-ASME approved shop
- Always a final check-out of assembled unit
- One complete bulk shipment
- Jet atomizing, tray and combinations available
- All stainless steel internals
- Self-adjusting to all loads
- 10,000 to 2,000,000 lbs. per hr. capacities

Automatic welding machine in L★A shop

From your initial inquiry through the shipment of the completed deaerator, L★A Water Softener Co. takes complete responsibility. You are assured of the finest workmanship and control with constant inspection and supervision by our qualified engineers as fabrication and assembly proceed. Consistant top quality equipment is the result.



100,000 lbs. per hr., 10 min. storage unit being loaded for delivery to eastern chemical manufacturer

You KNOW where your L★A Deaerator is made! And this complete control from one source enables L★A to deliver **on schedule** and ready for quick installation.

May we send you a copy of our new Deaerator booklet? Simply ask for Bulletin 102-A

L★A WATER SOFTENER COMPANY
1007 Air Way, Glendale 1, California
REPRESENTATIVES IN PRINCIPAL CITIES

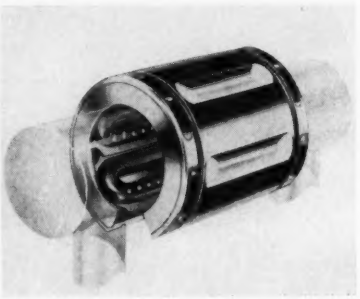
Demineralizers • Hot Process Softeners • Floc Treators • Deaerators • Zeolite Softeners • Dealkalizers

More EQUIPMENT NEWS

Begins on page 162

be determined without involving excessive hydraulic pressures; and, conversely, very small loads are determined without the complications of measuring very low hydraulic pressures.

Charles W Schneible Co,
32 Lee Court, New Rochelle, N. Y.



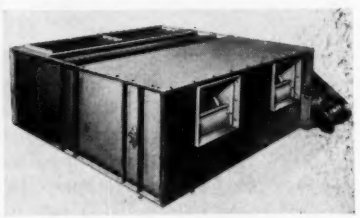
Linear ball bearing

130 • Linear ball bearing permits use o shaft support members along the length o shaft traversed by bearings. These bearings are known as open-type ball bushings and are said to be suited to applications where extreme rigidity or unusually long shafts are a requirement.

Open construction of bearing also permits adjustment of its bore diameter by use of set screws or other clamping arrangements. This feature eliminates shake or play by adjusting for a free-running line-to-line or slight preload fit.

Thomson Industries, Inc,
Manhasset, N. Y.

For more details on these items, use post cards p 171. Identify your request with item number.



Heating-ventilating unit

★ Large capacity heating and ventilating unit features sectionalized design. Nine unit combinations are offered in the line, ranging from a basic model supplying untempered make-up air to a deluxe model that provides heating, ventilating and humidification.

Deluxe model includes an insulated and baffled discharge plenum with insulated enclosure for motor mounting, fan section and coil with attached face and bypass section, and a combination filter-mixing box. ★Request further details direct from manufacturer, on company letterhead.

The Trane Company,
206 Cameron Ave, La Crosse, Wis.

(*Continued on page* 192)

Inside Story on POWELL
PRESSURE SEAL VALVES

Pressure seal valves may appear similar on the outside. However, the Powell Pressure Seal Valves are quite different in design and in manufacture. And the inside story on Powell Pressure Seal Valves is that every valve has PERFORMANCE VERIFIED.

Only the finest materials are used in Powell Pressure Seal Valves, and painstaking quality control is rigidly enforced through each step of manufacture. For example, every machining operation is accurately gauged. All parts are thoroughly cleaned and degreased and thoroughly inspected.

Because of Powell's painstaking quality control, plant shutdown through valve failure is practically unknown. Records from power and industrial plants the world over prove it.

Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our COMPLETE quality line which has PERFORMANCE VERIFIED.

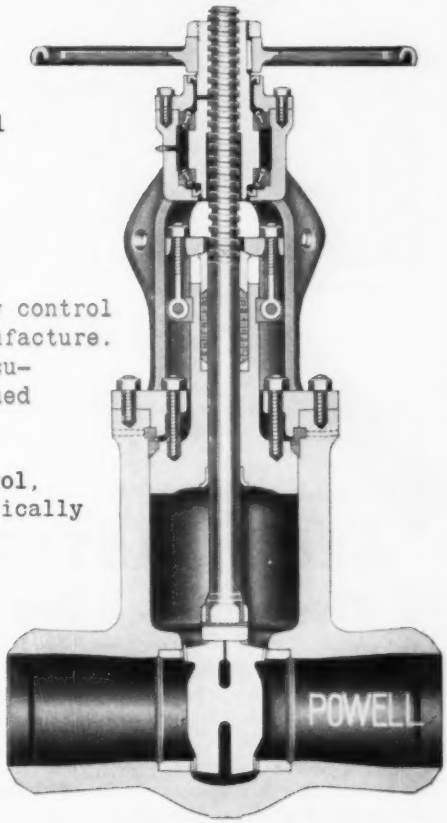


FIG. 11303 — (Sectional) 1500-Pound Pressure Seal Steel Gate Valve

Fig. 1314-A — 1500 Pound Integral Bonnet Steel "Y" Valve.

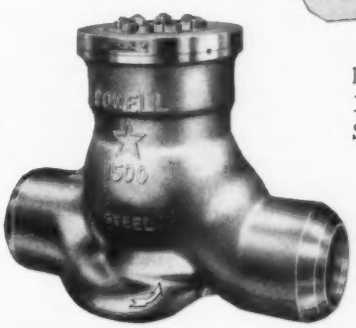


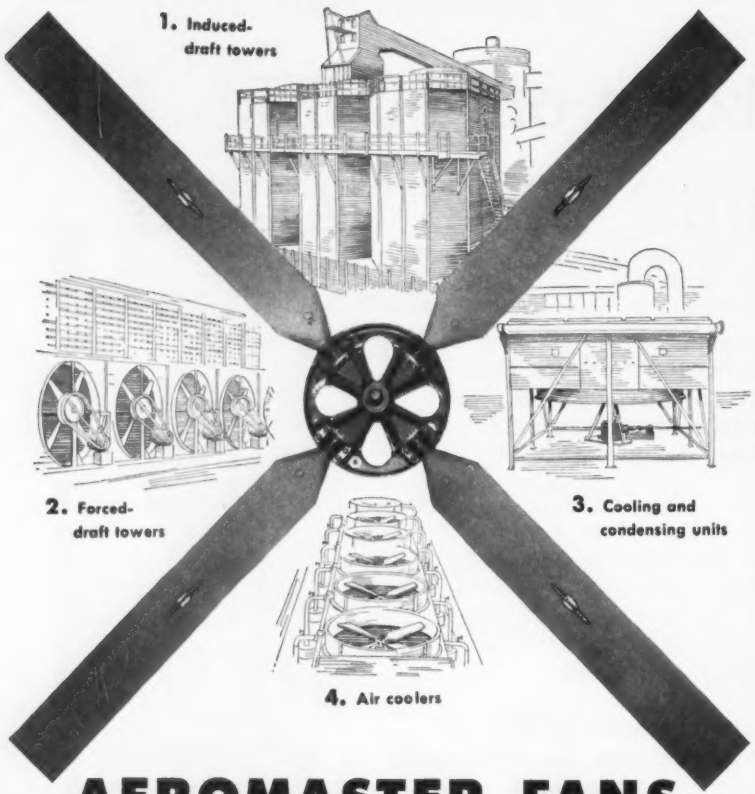
FIG. 11365 — 1500-Pound Pressure Seal Piston Guided Horizontal Lift Check Valve

PERFORMANCE PV VERIFIED

The Wm. Powell Company, Cincinnati 22, Ohio . . . 111th YEAR

POWELL VALVES

BRONZE, IRON, STEEL AND CORROSION RESISTANT VALVES



AEROMASTER FANS
First choice for all four

Ask the manufacturer . . . *ask the user* . . . what fan he prefers for his cooling equipment. Chances are he'll say Aeromaster.

Why? Because he knows from experience that Aeromaster Fans can be relied upon to give good service.

Aeromaster Fans are *precision-engineered,* adapted from high speed aircraft propellers. They have adjustable blade pitch and anti-flutter design . . . therefore, require less horsepower. And they last longer too, thanks to the exclusive Aeroloid blade coating to resist acids and alkalies, abrasion and weather. Overall result: Aeromaster Fans *give more cooling at lower cost.*

Available in 4, 6, or 8 blade styles, in diameters of 5 to 24 ft., with capacities up to 1,000,000 cubic feet per minute, all Aeromaster Fans are fully guaranteed.

Koppers also has trained engineering specialists available in principal cities, insuring prompt, expert Aeromaster Fan service. And Koppers is always ready to consult with you on special fan problems. Next time you plan a replacement of present fans, specify Aeromaster. When you consider new equipment, call on Koppers . . . always eager to be of service.

KOPPERS®

Aeromaster Fans

METAL PRODUCTS DIV. • KOPPERS COMPANY, INC. • BALTIMORE, MD. • This Koppers Division also supplies industry with Fast's Couplings, American Hammered Industrial Piston and Sealing Rings, Koppers Electrostatic Precipitators and Gas Apparatus. *Engineered* Products Sold with Service

MAIL COUPON TODAY FOR COMPLETE INFORMATION

KOPPERS COMPANY, INC., *Aeromaster Fans,* 2601 Scott St., Baltimore 3, Md.

Gentlemen: Please send me detailed information on Aeromaster Fans for .....(name and type of equipment to be cooled).

Name.....

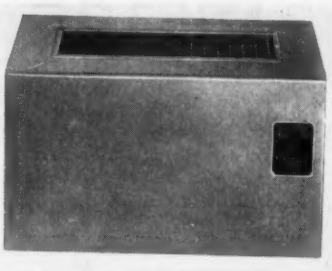
Title.....Company.....

Address.....

City.....Zone.....State.....

More EQUIPMENT NEWS

Begins on page 162



High-velocity control unit

136 • High-velocity under-window unit, *Model CM,* is designed for installation under windows or on any wall surface. It is said that adjustable grille used on unit assures rapid diffusion and draft-free distribution of the conditioned air. To prevent grille from being covered by objects that would prevent proper distribution of air, front of cabinet is sloped.

Barber-Colman Company, 115 Loomis St, Rockford, Ill.

For more details on these items, use post cards p 171. Identify your request with item number.

Cutting oils

139 • Series of cutting oils are said to be especially effective when applied to difficult broaching, gear hobbing and tapping jobs, where problems of high pressure, heat and friction exist.

One of the oils is said to increase gear hob life up to eight times more than normal length of service. Tap life and tool life on difficult pipe threading is also said to be greatly increased.

Tower Oil Company, 300 W Washington St, Chicago, Ill.

Pipe protection

► TRI-SUL-ITE is the new name for specially selected natural mineral gilsonite underground pipe protection, mined, blended and formerly marketed under name of *Insul-ite.*

Tri-sul-ite is said to be one of the few natural minerals which have been found successful for providing complete protection for underground pipes.

Manufacturer feels that this is a far more suitable name for the gilsonite product because, properly installed and cured, it forms three zones of corrosion protection, water impermeability and insulation.

Product is available in three types to meet most requirements. Proper selection of type of material depends on temperature of pipes protected.

G S Ziegler & Company, Great Neck, New York

6,000 horsepower in a single CLARK CBA-8 balanced/opposed compressor

Now, for the really big applications, Clark introduces the most powerful compressor ever built—the new CBA-8. The ability to handle tremendous horsepower, however, is not the only feature of this new compressor. Being extra heavy and rugged in all respects, it is the perfect choice for those services where extremely high pressures are required such as in the process industries and for high pressure wind tunnel applications.

High discharge pressure invariably causes a high pressure rise across the cylinders which results in heavy pin loads. The new CBA-8 is designed to carry pin loads of 100,000 pounds with ease. For large air compressor installations, at normal pressures, the CBA-8 will operate with minimum maintenance because of its heavy construction. The balanced/opposed design principle, originated by Clark, assures vibrationless operation.

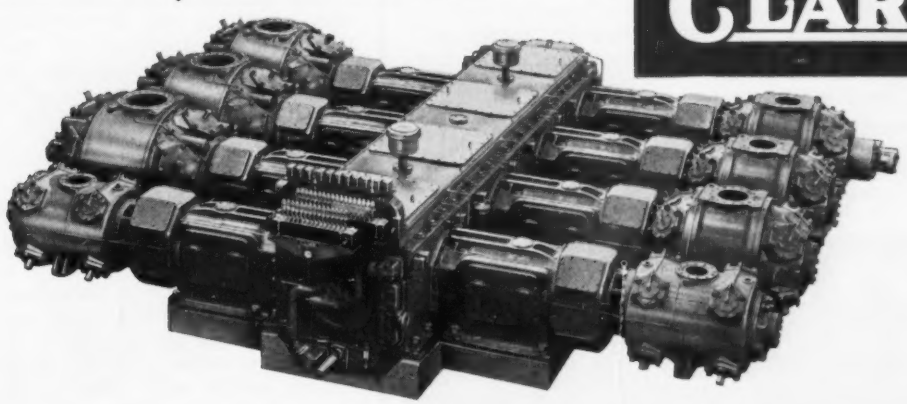
Two new CBA-8 units already have been delivered for a special application. Your Clark representative will gladly give you full details on this new unit.

CLARK BROS. CO. • OLEAN, N. Y.
One of the Dresser Industries
Sales offices in Principal Cities Throughout the World

Balanced/Opposed Compressors

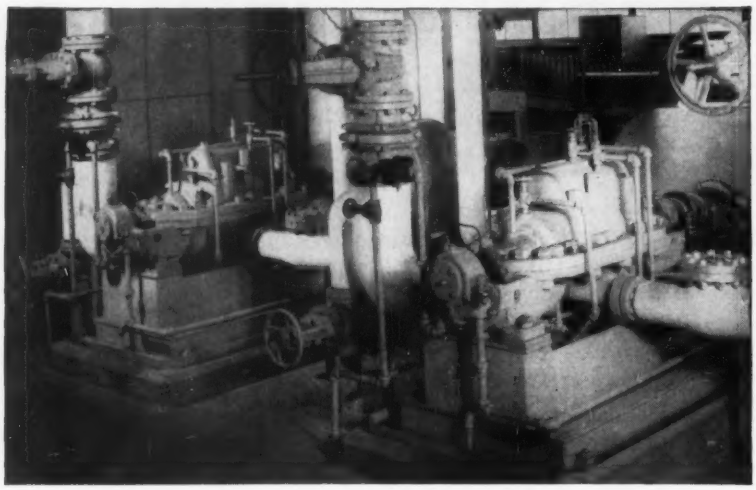
CLARK®

ONE OF THE DRESSER INDUSTRIES



PRODUCTION CONTINUITY

Begins in the Boiler Plant



Warren Six Stage Boiler Feed Pumps installed
at a Southern Board and Paper Mill.

Boiler Feed Pumps may look much alike, type for type, but it is well to keep in mind such intangible factors as:

- Experience and integrity of the manufacturer
- Dependability of product
- Know-how, Workmanship, Service
- Maintenance and Repairs
- Lost production due to down-time
- Early replacement because of "tight" original recommendations

It is impossible, of course, to get these items into your "specs," or the supplier into his "quotes," but don't overlook their importance with relation to price, possible future requirements and *production continuity*.

Get your share of "intangibles" . . . specify

WARREN QUIMBY PUMPS

P-34

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC.

Warren, Massachusetts

My biggest boner

In the Merchant Marine I learned to always check the work of my oilers and firemen. But when I came ashore, months of good routine operation evidently made me complacent.

My plant was a refrigeration job, with two corliss engines, driving 100-ton ammonia compressors. Steam was supplied by a 400-psi 50,000-lb-per-hr oil-fired boiler, with chain-pull soot blowers.

One day, the fireman blew tubes as usual during the noon-hour slack load. The back of boiler had two soot blowers with chains. While fireman went back to blow tubes I, as watch engineer, covered the combustion-control board out front.

Fireman had just finished operating the second blower when there was a sudden boom. Explosion door stood straight out. Fire room was immediately filled with soot and black smoke. Workmen eating lunch in the machine shop rushed suddenly for the door, which added to confusion. I tripped the fuel oil at the control board, but was unable to see more than a few feet. When the smoke did finally clear, I found the trouble behind the boiler, along with a bewildered fireman.

Hanging from the boiler casing's back was a third chain, which the fireman had evidently not noticed until this day. Then he did discover it and assumed it was another soot blower. One pull on the chain was enough. You guessed it. The chain was attached to the uptake damper. That one pull closed the damper so tight it took us ten minutes to open it again.

Needless to say, the Chief had the chain removed. We cleaned soot from the boiler room all that week. Big lesson I relearned was never to assume a man knows everything about a job. Always brief him well. If I had taken the time to show the fireman the third chain and explained its purpose, the accident would never have happened.

W Popp *Kingston, Tenn.*

BASICS

Continued from page 148

circuit, essentially a plating circuit, sometimes occurs in the earth. It is very undesirable since it decomposes underground pipes. Metal pipes may be used as a grounding connection for an electrical system, or may pick up currents in the earth. If the earth has a chemical constituency to cause

New pipe insulation goes on fast in one operation

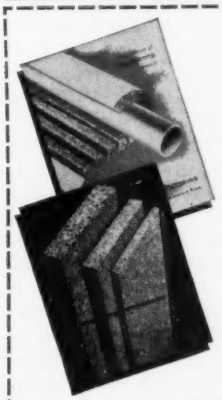
The speed with which Armstrong LT Cork Covering goes on low-temperature pipes results in substantial time and labor savings. This new kind of insulation is made of cork segments adhered to a backing of asbestos paper and aluminum foil laminate that seals out moisture and resists fire. Fast application requires only cementing the flap in place and sealing the end joints with vaporproof tape. There are no wires or bands needed, no cloth, twine, or paper to be wrapped around the insulation, and no vapor barrier to apply.

A highly efficient insulation for all low-temperature piping, LT Cork Covering is only one of the many quality products in the Armstrong line. A complete contracting service, geared to install these insulations economically and efficiently, is also available. Free booklets give full details. Check the ones you want in the coupon below.

Armstrong

INDUSTRIAL INSULATIONS

for temperatures from –300° F. to 3000° F.



☐ Armstrong LT Cork Covering, for all low-temperature lines

☐ Armstrong Corkboard, for all low-temperature rooms

† Trade-Mark

☐ Armstrong Armaglas* Insulations, for low-temperature rooms

☐ Armstrong Armalite†, a new, lightweight insulation for cold rooms

Armstrong Cork Company
2001 Riggs Ave.
Lancaster, Penna.

Please send me the free booklets checked. ☐

Please have an Armstrong representative call. ☐

Name .....

Position .....

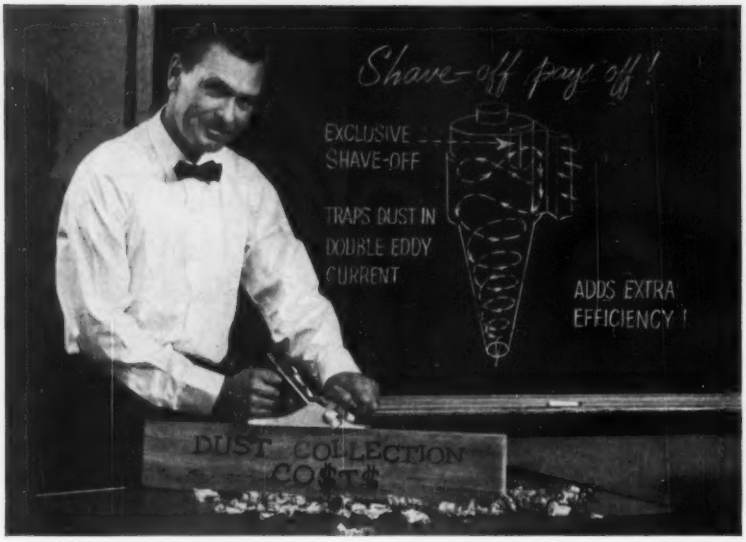
Company .....

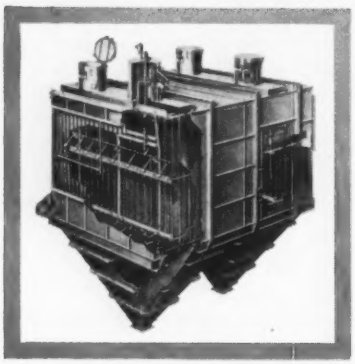
Address .....

City ..... Zone .... State .....

* ® Armstrong Cork Company, manufactured for Armstrong by Owens-Corning Fiberglas Corp.

How Buell's exclusive Shave-off pays off in extra dust collection efficiency

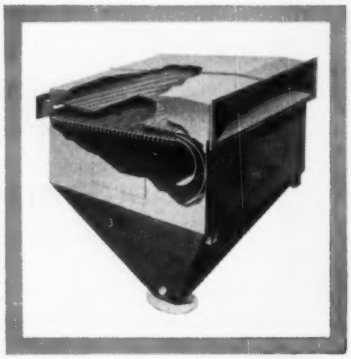




Buell SF Electric Precipitator also delivers extra dust collection efficiency, due to unique Spiralectrodes and Continuous Cycle Rapping.

Buell Low Resistance Fly Ash Collector combines top efficiency with low draft loss, for either natural or mechanical draft installations.

Proper proportioning, side entry of dust-laden gases, add even more extra efficiency and long, maintenance-free life to Buell Cyclones. Large diameter design eliminates bridging and clogging, keeps efficiency high under varying loads.



For more specific data about Buell's *extra efficiency*, write Dept. 50-A
Buell Engineering Company,
70 Pine Street, New York 5, N.Y.

buell®

MECHANICAL ELECTRICAL *Experts at delivering Extra Efficiency in* **DUST COLLECTION SYSTEMS**

BASICS

Continued from page 194

electrolytic action, the parts of the pipes that act as anodes will be eaten away, sometimes quite rapidly.

Batteries are electrolytic circuits that produce an emf and cause current to flow in an external circuit. *Primary cells* produce electricity by nature of their component materials (like the familiar "dry" cell). *Secondary cells* must have electricity fed into them to produce the chemical compounds that will later give back electricity. (Strictly speaking, a *battery* is a combination of two or more cells, but popularly, one cell is also called a battery.)

A simple primary cell is made of a zinc plate, a copper plate and a sulfuric acid solution. Chemical action of this combination causes an emf across the external circuit and, if the circuit is closed, current will flow. Sulfuric acid molecules dissociate into positive hydrogen ions and negative sulfate ions. Positive hydrogen ions drift toward the copper plate because of chemical attraction and pull electrons out of the copper. When the copper plate gains sufficient positive charge, positive ions are no longer attracted and action stops. But if the circuit is closed, and new electrons can flow into the copper plate to take the place of those lost, action continues. Sulfate ions are, at the same time, attracted to the zinc plate where they give up electrons that eventually make their way through the external circuit to supply the copper plate.

Sulfate ions, after losing their charge, react chemically with the zinc to form zinc sulfate which is neutral and inactive. Zinc and sulfuric acid are thus consumed until the cell is "dead." Comparing the primary cell with sketch, p 194, *polarity* of the plates will be reversed as will *direction of conventional current, I*. Oxygen ions are replaced by sulfate ions and load replaces the generator. If the plate at right, in sketch, is considered to be copper, its polarity will now be positive and it will be called the anode. Similarly, the zinc at left will be negative (cathode). Direction of electrons in external circuit and ions in electrolyte will be the same.

Secondary cells (storage batteries) are more complicated. Active surfaces of the plates consist of compounds that are built up during the charging period and which pass into solution during discharge. The cell does not go dead (in normal operation) like primary cells. Instead, chemical action can be reversed by forcing charging current through the cells in the direction opposite to the current that supplies power during discharge of the cell.

Next month: Electromagnetism.

Look for this honored Name Plate . . .

STEAM GENERATORS by Vogt

a guide to advanced designs in package unit and custom built steam generating equipment

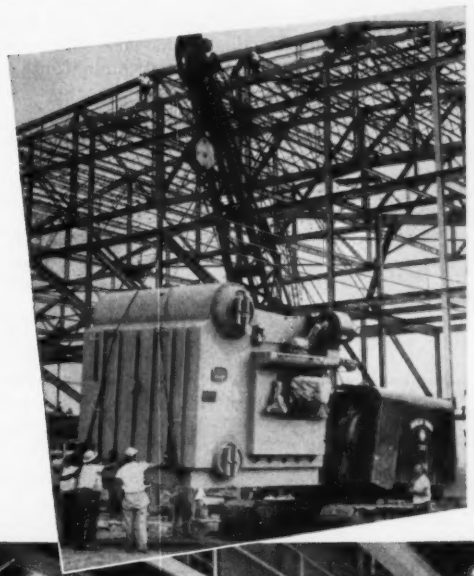
Vogt steam generating units are available in types and sizes to meet individual plant needs for power, processing or heating.

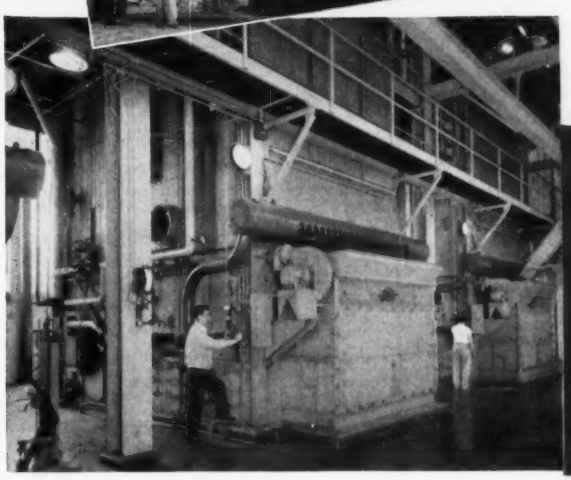
Package units range from 10,000 to 40,000 pounds of steam per hour while custom built units are obtainable in the larger capacities. Available in bent tube types and straight tube, forged steel sectional header types for solid, liquid or gaseous fuels burned singly or in combination.

Write for Bulletins, Dept. 24A-BP

HENRY VOGT MACHINE CO.
Box 1918, Louisville 1, Kentucky

SALES OFFICES
New York, Chicago, Cleveland, Dallas, Philadelphia
St. Louis, Charleston, W. Va., Cincinnati, San Francisco

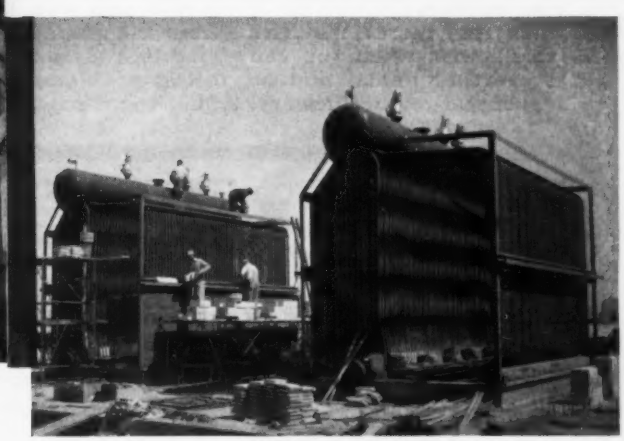




One of three 15,000 #/hr. capacity package unit steam generators for a State institution.

Two of three 41,000 #/hr. steam generators installed in Medical Center Steam Plant, Louisville, Ky.

Erecting two 50,000 #/hr. steam generators at Kelly Air Force Base, San Antonio, Texas.



OTHER VOGT PRODUCTS
Drop Forged Steel Valves, Fittings and Flanges in a complete range of sizes • Petroleum Refinery and Chemical Plant Equipment •. Steam Generators • Heat Exchangers • Ice Making & Refrigerating Equipment

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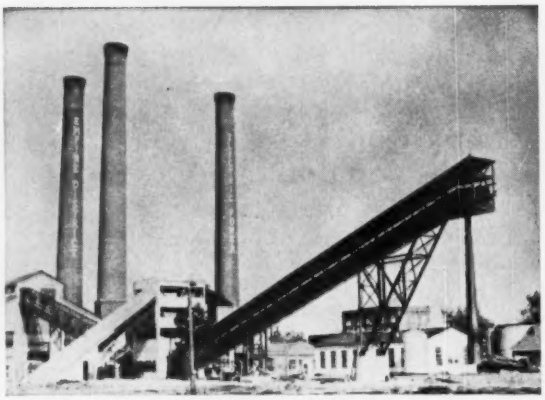

McNally Pittsburg developed this 250 ton per hour system for the EMPIRE DISTRICT POWER & LIGHT CO.

McNally Pittsburg assisted in developing this 300 ton per hour system for the KANSAS POWER & LIGHT CO.

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Are you paying "extra fare" luxury rates for that last ride your coal must take from the truck, car, or barge, to your bunkers?

Why pay more? Why risk breakdowns, when you can *save* extra "profits" and be sure of year-round efficiency.

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CONDENSER DESIGN

Continued from page 81

each end of the condenser with a synthetic rubber. This helps in sealing the joints where the tubes are rolled into the tube sheets.

Steam dumping is not new. We have often used this arrangement on condensers in stations where waste-heat boilers supplied steam to turbines. These boilers normally generate a consant steam output; when the steam is not needed by the turbines it is dumped in the condenser.

When dumping live steam it must be desuperheated and throttled to permissible levels for the equipment in the bypass, like reheaters, heaters, turbine-exhaust casing and the condenser. Under emergency conditions as much as 70% of full-load steam flow may be dumped. As low a temperature as possible should be held near the turbine-exhaust nozzle, and piping must be large enough to avoid speeding up the steam to sonic levels.

Dump steam should be reduced to about 65 psia outside the condenser and expanded to condenser pressure and temperature in two steps through the concentric internal and external pipes, Fig. 6. These pipes are perforated with slots or holes and form the steam dump assembly, located in the condenser neckpiece.

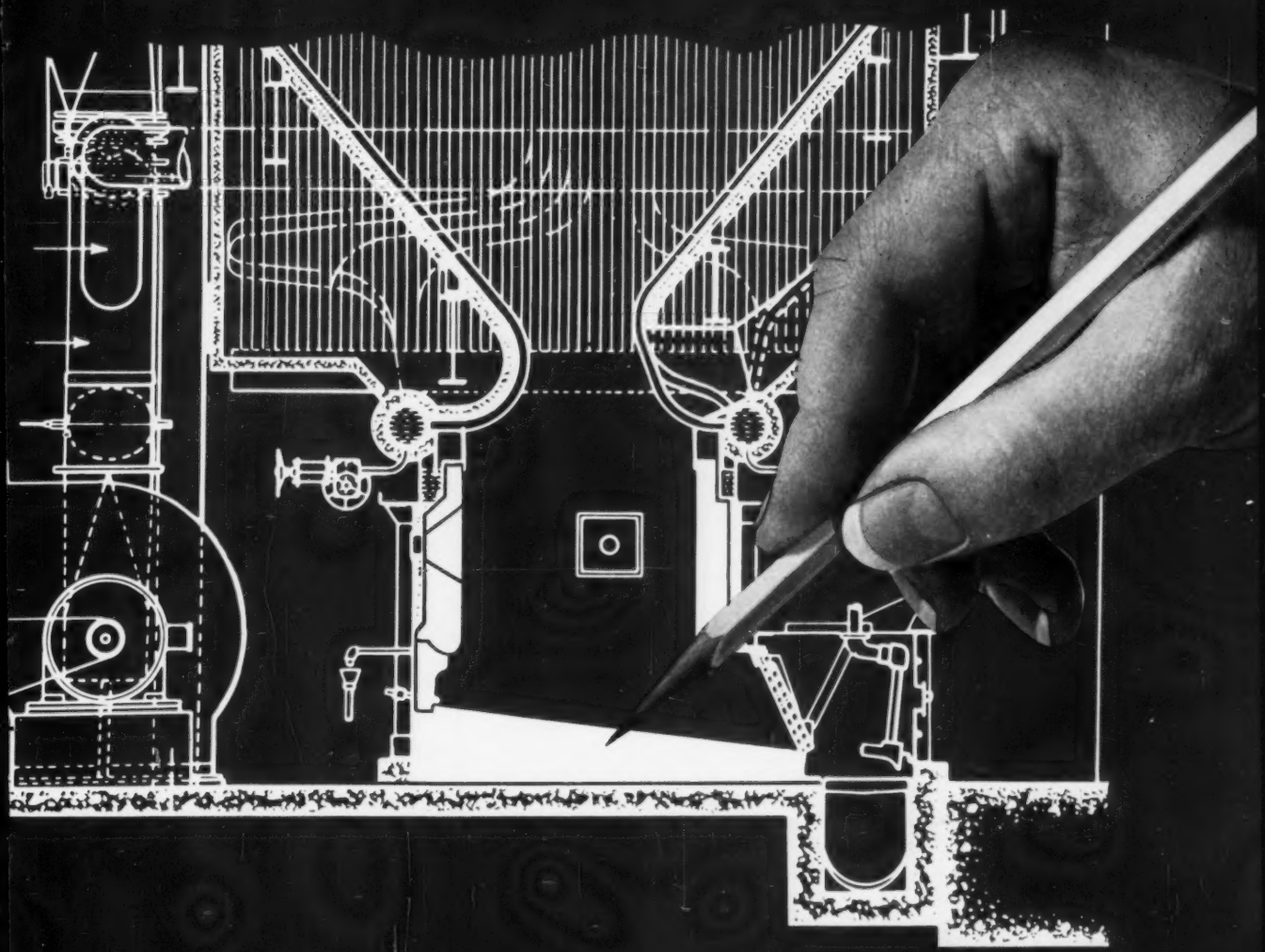
The internal perforated pipe, connected directly to the bypass system, should be of stainless steel. The water spray at the junction of the steam dump and bypass will cause impingement and shock that is too severe for ordinary steel.

Possible size of the steam dump assembly, together with vacuum-stress bracing already in the condenser neckpiece and the possibility of adding conventional heaters and extraction-steam piping are shown in Fig. 7. Other locations may have to be used for equipment entirely extraneous to the condenser or else adversely affect the condenser performance.

Conclusion. Condenser performance for a plant using a once-through boiler becomes the "tail that wags the dog." Careful consideration must be given each of these problems to prevent condensate contamination which may cause frequent plant shutdowns.

Air Reduction Pacific Co will build a new air liquefaction plant in the Los Angeles area. The new plant which is scheduled for completion during the second half of 1957 will cost over $7½ million. It will supply the demand for oxygen, nitrogen and argon in the California, New Mexico and Arizona industrial areas.

How to draw the line on ashpit maintenance



"Let's put Kaocrete here"

Relining ashpits is expensive and time-consuming. That's why more and more utilities and industrial companies are specifying a heavy-duty refractory castable such as B&W Kaocrete D. On job after job, it has withstood the heavy abrasive or erosive attack of sprays, jets, rakes or shovels.

The reason? Specially designed Kaocrete D has the strength and hardness needed for tough ashpit service. It has unusually high resistance to abrasion, erosion and spalling. It saves time because it can be poured or gunned into place. For less severe abrasive or erosive conditions, B&W recommends Kaocrete A.

Get the facts and figures on these B&W Refractory Castables from your local B&W Refractories Engineer.

Send for Bulletin R-40 which gives data on B&W Kaocrete Refractory Castables for lining ashpits.

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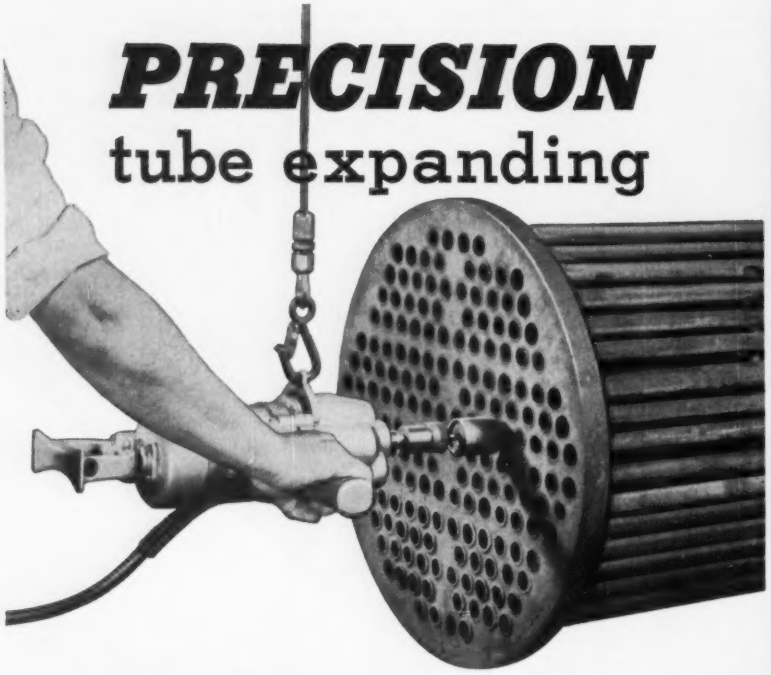
R-34b

PRECISION
tube expanding

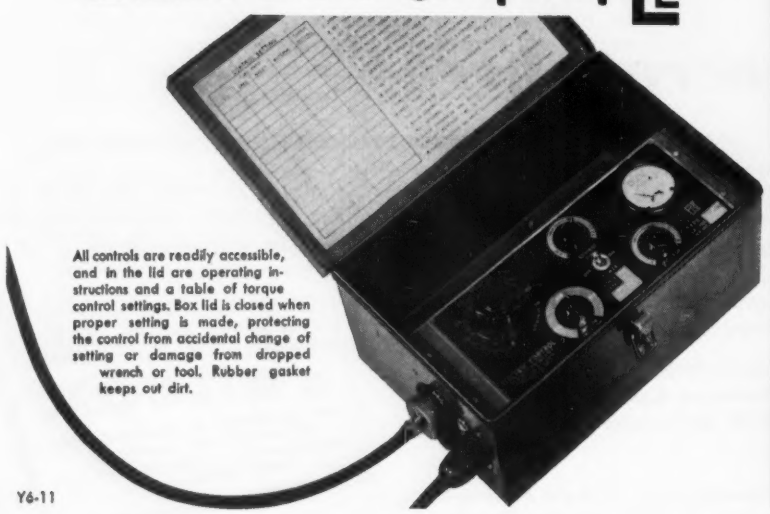


ELLIOTT electrical control assures tight joints!

The Elliott torque-limiting device enables your operators to get tight, uniform tube joints *every time!* This compact, simple electrical control reduces the chance of tube failure, and tube sheet distortion. By adjusting the Torque Control Knob for the size and kind of tube being rolled, the correct expansion is assured for each tube—regardless of small variations of tube or hole size. A signal lights up, and the motor automatically stops when the tube has been rolled right. Built-in voltage balancer eliminates the need for a voltage regulator.

Elliott Tube Expanders with the Electric Control, described above, form a "package" that takes the guesswork out of tube expanding, and speeds up the operation. For prices and further data, contact the nearest Elliott district office, or write Elliott Company, Lagonda Division, Springfield, Ohio.

ELLIOTT Company



All controls are readily accessible, and in the lid are operating instructions and a table of torque control settings. Box lid is closed when proper setting is made, protecting the control from accidental change of setting or damage from dropped wrench or tool. Rubber gasket keeps out dirt.

Y6-11

MARMADUKE

Continued from page 150

that made my life interesting before lunch. After lunch, things were almost as bad.

"We broke down during three full-speed trial runs. It looked like we wouldn't complete the run before midnight. By the time I dragged myself into the messroom for dinner, my brain was spinning like an off-balance flywheel.

"Just as I dug into my chow, the Chief sent word that the main feed pump was losing its discharge pressure. He and his assistants were below, watching everything like a hawk because after the trials the ship was going to be their baby. I wanted to finish that trial run without stopping again, so I clamped a pork chop between my teeth, dropped my hardware and hotfooted below.

"That morning we had found a hunk of burlap in the inboard feed pump's first-stage inlet. It had probably worked its way along the suction line from the deaerator or from a reserve feed tank in the ship's double bottom. So sliding down the handrails, I tried to connect that rag with the present trouble. When I hit the floor plates, the Chief had just telegraphed the bridge that he was stopping.

"He was right about losing water. That motor-driven centrifugal feed pump was haywire, no doubt about it. Every time I tried starting the pump, there would be a dull 'klunk' and discharge pressure would nose-dive from the normal 600 psi to 400. So the pump couldn't force water into the steam drums against the 480-psi boiler pressure. By that time, water in the boiler-gage glasses was almost out of sight. I had the small standby feed pump started and put on the line. Then I started the main turbine but throttled it enough to keep the water showing in the glasses.

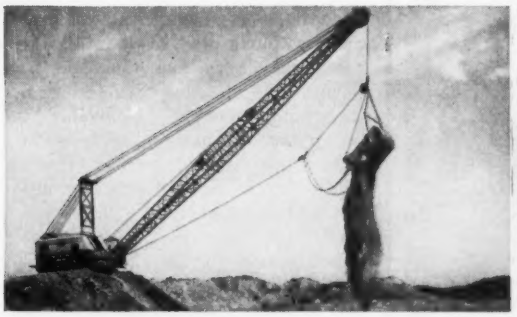
" 'Change to your outboard feed pump, Chief,' I shouted. But after that pump had been running for about three minutes, we heard the same 'klunk' and pressure dropped again.

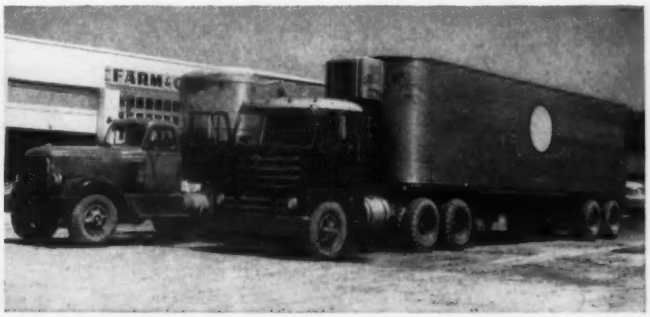
" 'Switch back to the inboard pump,' I ordered. He did and in about three minutes the pressure dropped again.

"Those pumps were acting the same way when we found the burlap so all I could think of was an obstruction in their suction line. Looking for a likely spot for something to lodge, I spied a tee in the suction line about 10 ft from the two pumps.

"Every ship has a standby feed pump, often called the port pump. This one was the usual vertical simplex type. It was steam driven so water could be fed

For every type of diesel operation—



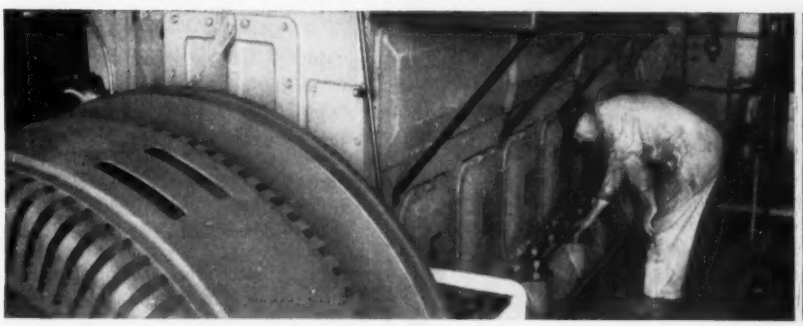


FOR MECHANIZED DIESELS, there's a Cities Service diesel oil for every operating condition. Most widely used is Cities Service C-300 Motor Oil, which has improved performance and lowered maintenance costs for a host of truckers, quarry operators, and mining men. Shovel above logged 16,280 hours with no repairs, no increase in oil consumption. A Cities Service Lubrication Engineer will gladly show how you can achieve similar results.

the right track to greater profits

FOR RAILROAD DIESELS, Cities Service now offers a brand new oil . . . Pacemaker RD-80. Proven superior by over 50 million miles of operation on major railroads, new Pacemaker RD-80 reduces oil consumption up to 10%, cuts engine deposits 200% better than previous oils. Also gives superior protection of ring belt area. According to a leading engine builder, its oxidation stability is "the best of any oil tested."

is Cities Service Diesel Oil!



FOR STATIONARY DIESELS, Cities Service C-300 Lube Oil has won high praise from numerous users. Example: Paulding Light and Water reports 16,587,402 H.P. hrs. without oil change; gets 23,205 BHP hrs. per gallon consumed! For more information, write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

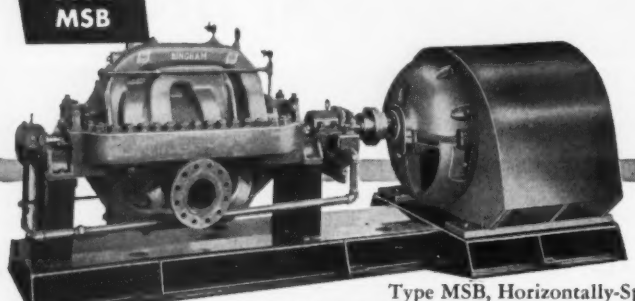
Specify

Bingham

"DOUBLE VOLUTE"
BOILER FEED PUMPS

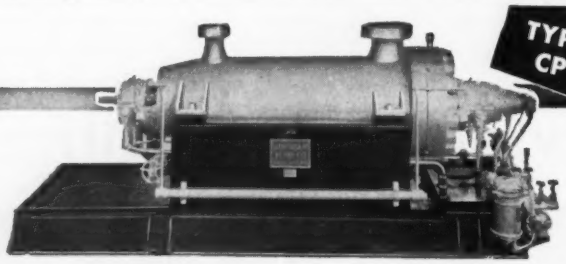
for the ultimate in dependability
IN HIGH PRESSURE SERVICE

TYPE MSB



Type MSB, Horizontally-Split Case, Multi-Stage Boiler Feed Pump field proven for 1200 lbs. working pressure. Integrally cast cross-overs and evenly spaced case bolting located uniformly close to the shaft center line, enclosing a minimum pressure area, eliminate case distortion and inter-stage jetting.

TYPE CP



Type CP, Multi-Stage, Double-Case Boiler Feed Pump with forged outer barrel for high pressure service.

All BINGHAM Boiler Feed Pumps feature: (1) "Double Volute" construction, resulting in full radial balance of the rotating element *throughout the entire operating range of the pump.* (2) Double suction first stage for low NPSH. (3) Balanced axial thrust (no balancing drums needed). (4) Kingsbury Thrust Bearings. (5) Stuffingboxes subjected to suction pressure only. (6) Design for High Speeds.

Bingham SINCE 1921

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MARMADUKE

Continued from page 200

to the boilers if electricity konked out. Standby pump was down in the fireroom, one deck below the main feed pumps. The deaerator tank feeding all three pumps was about 60 ft above, in the engine-room hatch. The deaerator's suction line dropped down to the main feed pumps on the platform, then down to the standby pump. So there was a good 25-psi head of 242-F feedwater at the pump's suction all the time.

"Standby pump down in the fireroom was running, but running alone she could only pump enough water to keep the ship's propeller turning at 20 rpm. Our full speed was 120 rpm. There was a heavy sea running and at 20 rpm we just barely maintained steerageway. We were rolling like a drunken sailor. I knew that if we stopped, we'd really be bounced around.

"We switched standby pump's suction to the reserve feed tank. It supplied extra makeup feed to the boilers while the main feed pumps were taking suction from the deaerator. During this time, we switched the inboard and outboard main feed pumps every few minutes or so.

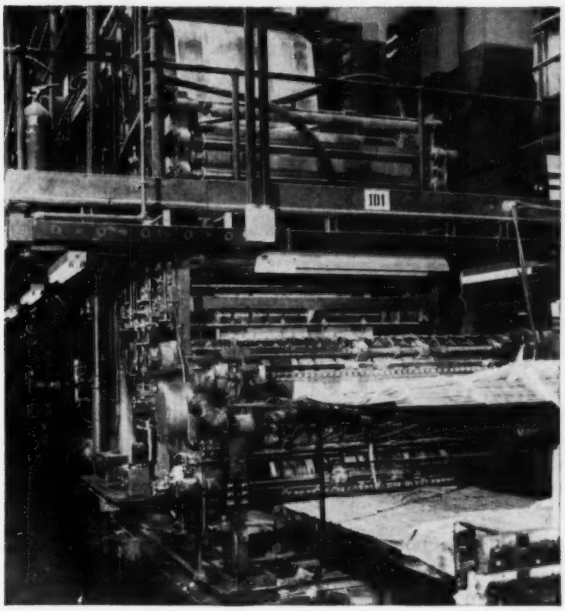
"Suddenly, I noticed the discharge temperature from the pump shoot up from the normal 242 to 252 F. Just as it reached 252 F, I heard that 'klunk' again. Each time we switched a main feed pump, temperature would rise gradually, then discharge pressure would drop. My first brainstorm was that the rise might be from friction caused by pump's impeller churning water that wasn't going anywhere. But then I noticed that the suction temperature was rising at the same time. That knocked my friction theory slightly cockeyed.

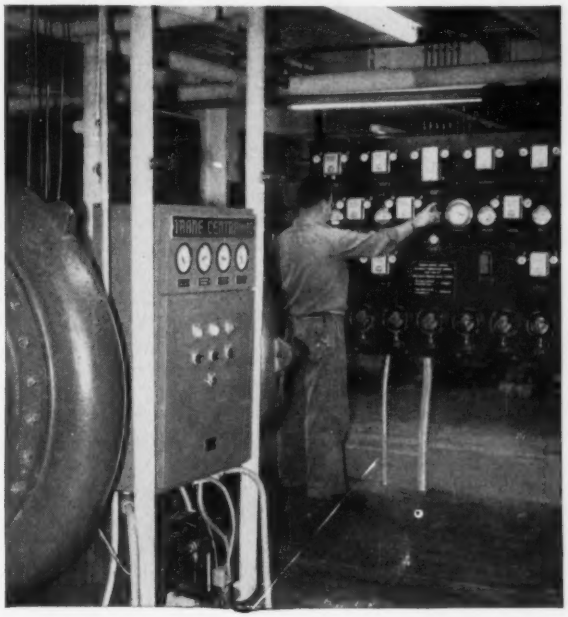
"With the pump's suction temperature in cahoots with its discharge temperature, I had no reason to tear into the suction line for an obstruction. About that time, the Chief started bellyaching. 'This is the worst ship I ever sailed on,' he squawked, getting pink around the gills. 'I'm getting off as soon as we tie up at the yard."

"But I was having too much fun trying to outsmart those temperamental pumps to listen to his beefing. I turned the thing over and over in my noggin. I knew there was only enough heat going to the system to keep it at 242 F. And yet, there it was registering at 252 F. I shut down both feed pumps again, and again the temperature nose-dived to normal. Then I opened one pump, let it run a few minutes and temperature shot back up to 252 F.

Deaerator pressure and level had remained normal since we put the standby

Controlled Water Supply Cuts Downtime... Helps Meet Production Deadlines





PROBLEM: *The Condé Nast Press* formerly used a large volume of city water in the cooling rollers of its giant press batteries. High speed, quality printing of leading magazines such as* House & Garden *and* Glamour *requires a constant source of chilled water to quick-set ink after it is heat-dried. Trouble developed in the summer months—water pressures were too low and the temperatures too high. There was even the threat of a complete water cut-off during shortage periods.*

SOLUTION: *The answer proved to be recirculation of the water in a closed system, the use of mechanical cooling equipment and the installation of a flexible, high-efficiency control system to insure uniform water temperature and pressure. The cooling load is handled by two 150 hp compressors and a large heat exchanger. Process water flows through the cooling rollers on the presses and is either returned to the refrigeration units or to the heat exchanger for recooling.*

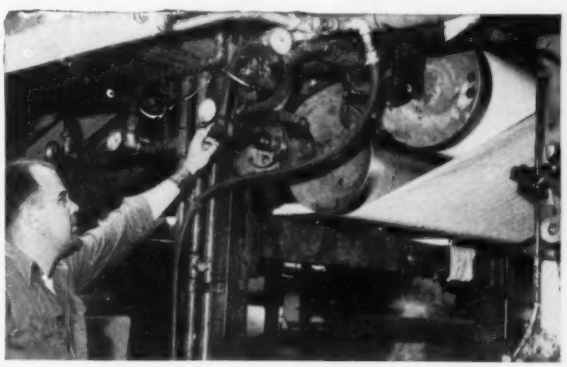
Precision, waste-free operation of this interesting system is provided by a specially-engineered Johnson Automatic Temperature Control System. The compressors are operated, in sequence as needed, to maintain a constant chilled water temperature. Sensitive, fast response to sudden load changes is a must. As presses start and stop, load shifts often range from zero to 100 per cent and vice versa within minutes.

Whenever the outdoor temperature is sufficiently low, compressors are automatically stopped, and the process water is chilled by passing condenser water from the cooling tower through the heat exchanger. Condenser water temperatures are regulated by a Johnson Thermostat controlling the cooling tower fans. This automatic changeover arrangement minimizes operating costs and helps extend the life of the compressors.

Constant water pressure is maintained by a Johnson Pressure Regulator which modulates a by-pass valve.

If you have a problem of heating, cooling, humidity or process control, Johnson can provide you with an equally successful, economical solution. The recommendations of a nearby Johnson engineer are yours without obligation. Johnson Service Company, Milwaukee 1, Wisconsin. Direct Branch Offices in Principal Cities.

*The Condé Nast Press, Greenwich, Conn. J. Gerald Phelan, architect, Bridgeport; Fletcher-Thompson, mechanical engineers, Bridgeport; John Winkel Co., Inc., mechanical contractor, Larchmont, N. Y.



RESULTS: *Variations in the supply, temperature and pressure of water have been eliminated. Downtime is reduced as accurate temperature control prevents excessive ink build-up on the cooling rollers. Application of a heavier ink film can be used to improve magazine quality. Close production schedules are met consistently—without regard to outside water sources.*

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MARMADUKE

Continued from page 202

feed pump on the reserve feed tank. But—and this was another thing that had me buffaloed—the deaerator's discharge temperature was higher than the corresponding temperature of the 12-psi steam heating the deaerator.

"By that time some of the shipping line's top brass and the Chief were griping openly to one another. But I shut my ears to their gaff and tried another tack. I throtbtled the 12-psi steam in the deaerator coils to reduce the feedwater temperature; the temperamental main feed pump calmed down and maintained the needed pressure without overheating. All I had to worry about now was the extra heat getting into the pump's suction line. Where was it coming from?

"Just then the Chief yelled over to the Second Assistant 'Hey there, Second, did you get those readings from the boiler-water samples like I asked?'

"Second yelled back, 'I've been working on it right along, Chief. I'll have 'em soon.'

" 'Why didn't you tell me you were sampling boiler water,' I asked the Chief, getting a hot idea. 'I think that's our trouble.' The Chief and the others gave me a fishy look and scooted over to see what I was up to.

"For the first time, I noticed that the ¼-in. copper sampling line from the feed pump's suction line under the deaerator had no check valve.

" 'Here's the trouble,' I said, pointing to the valve. 'There's no check valve here. That means that 452-F sampling water from the boiler drums is leaking back, heating the feedwater going to the pumps.'

"Just then the Second Assistant piped up, 'Come to think of it, Mr Surfaceblow, I found that sampling valve and the ones on both boiler drums wide open. I just closed them.'

" 'That's it,' I yelled, happy as a sailor spying a mermaid. 'When you opened the valves on your sampling manifold, the hot boiler water flowed back into the suction line.' But before I could continue, the Chief cut in. 'Oh yeah? If that's the trouble, then why didn't that reciprocating standby pump get vapor bound and knock herself out when we had her on the deaerator?'

" 'Because she's a deck below the main feed pumps,' I answered. 'That extra head of 12 ft is enough to take care of the 10-degree temperature rise.'

"I had the Second Assistant close all the sampling valves tight. In a few minutes the main feed pump settled down and we put the main turbine on full throttle. With no more 452-F

(*Continued on page* 208)

NEW EQUIPMENT *and* NEW METHODS

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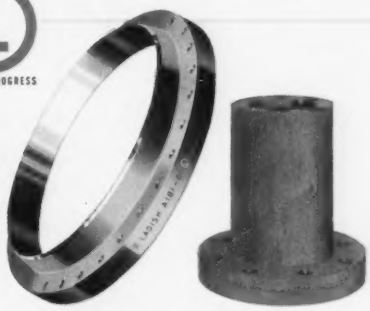

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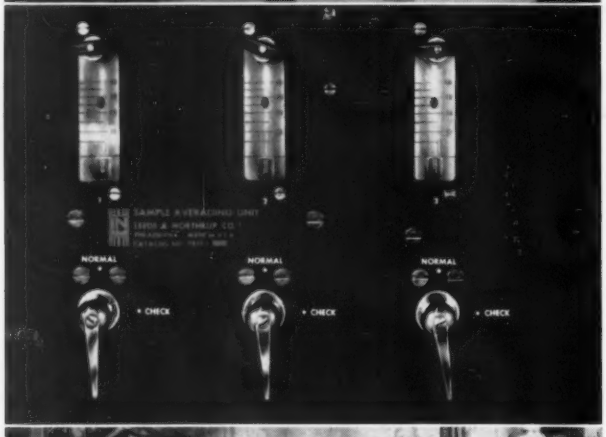

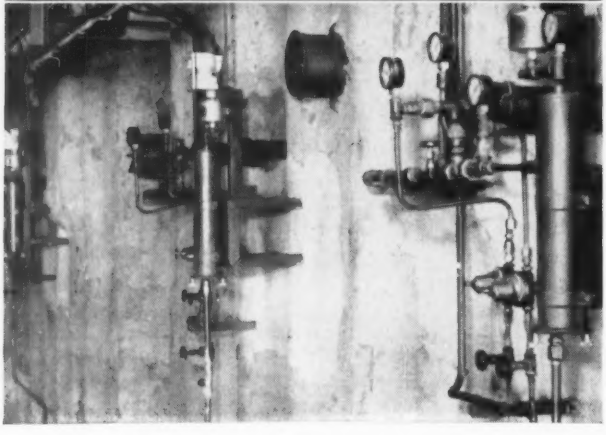

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And, in analyzing and recording, the speed of response of the Speedomax Recorder, coupled with the efficient operation of the L&N Magnetic O_2 Analyzer, increases speed and accuracy of O_2 analysis and recording even further.

Why not learn more about this new Speedomax O_2 equipment and what it can do for you? Write to Leeds & Northrup Company, 4910 Stenton Ave., Philadelphia 44, Pa.

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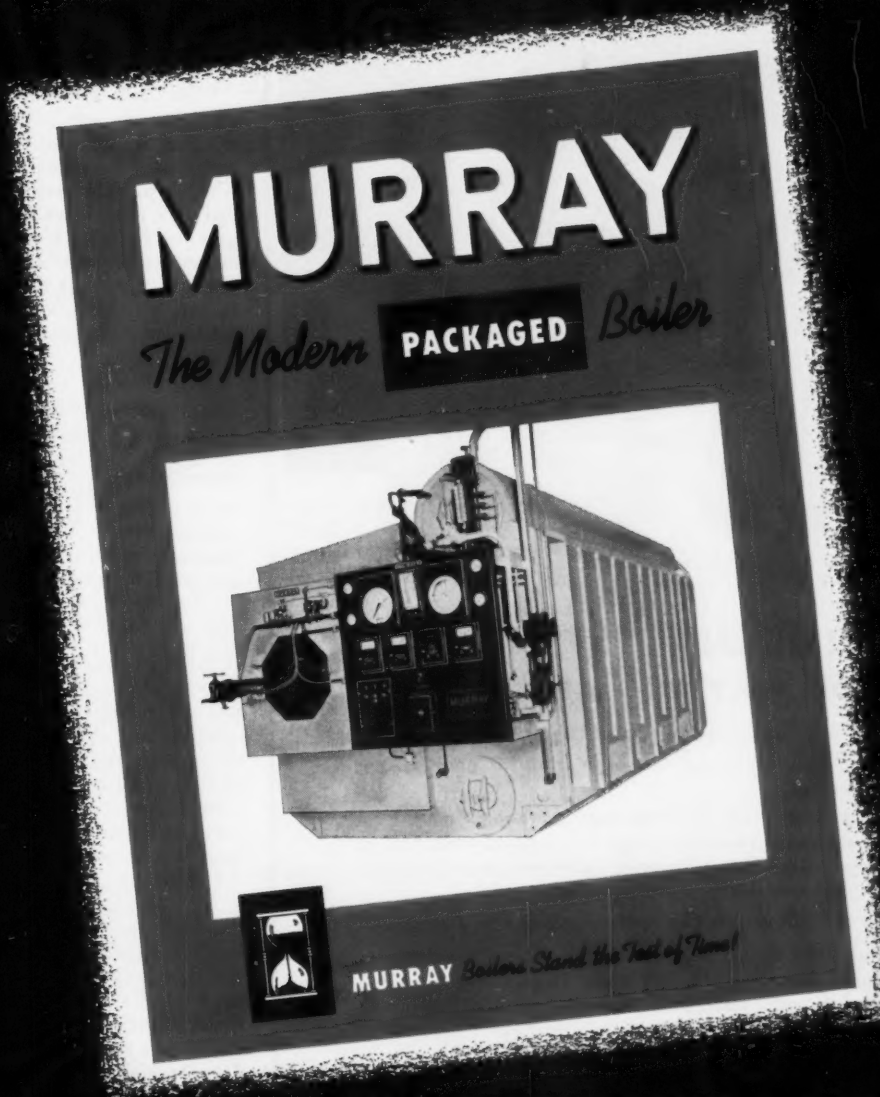
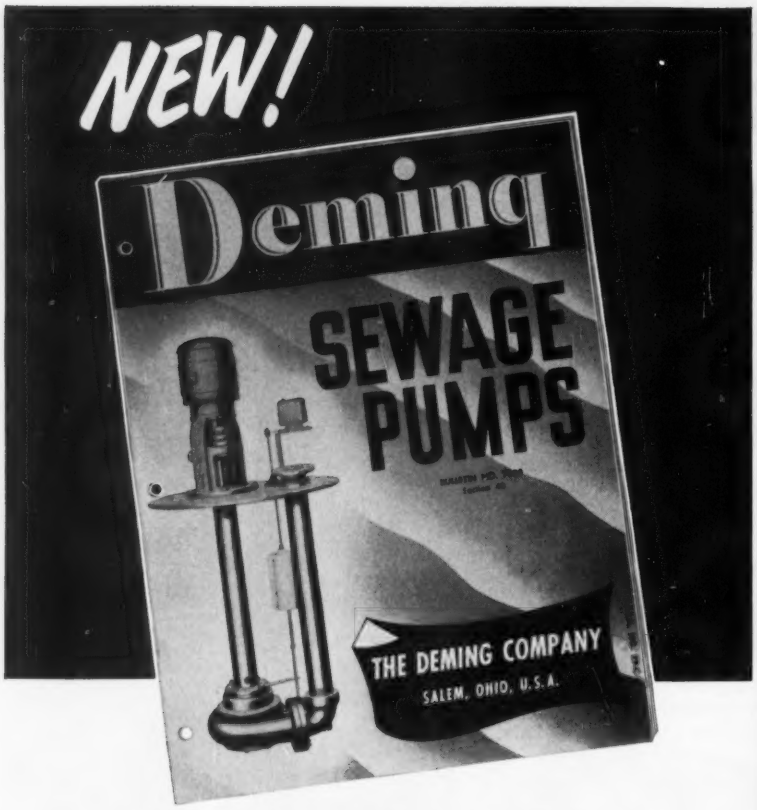


MURRAY packaged boilers are designed to meet today's need for compact, low cost, reliable heating and generating plants . . . When you install a MURRAY packaged boiler, you get the benefit of over 85 year's experience exclusively in the manufacture of boilers and allied products . . . Write for new folder, "MURRAY, The Modern Packaged Boiler," which gives complete information.

MURRAY IRON WORKS COMPANY · BURLINGTON, IOWA



Standardized Line

FOR WET AND DRY PITS

Check this new standardized line of Deming Sewage Pumps. BULLETIN 7500 shows their modern features and explains their advantages.

Heavy duty construction, close tolerance dowelring fittings from motor base through to pump casing, and positive alignment of all rotating and guide-bearing parts assure smooth, dependable operation and a minimum of maintenance.

And note this: Obsolescence factors reduced to a minimum!

Sizes range from 2½ to 4-inch discharge. Pumps handle solids from 1½ to 3 inches in size. Single and Duplex units available for wet and dry pit installations. Capacities range to 900 g.p.m. and heads to 110 feet. Units can be furnished with various types of drives up to 20 H.P.

AND NOTE THIS:

Quick deliveries assured. Repair parts available for prompt shipment.

Send for Bulletin 7500 NOW!

THE DEMING COMPANY, 547 Broadway, Salem, Ohio

Pump it with STANDARD

DEMING PUMPS

and roll up SAVINGS!

MARMADUKE

Continued from page 204

water feeding back into the pump's suction, we were squared away. Then we stopped the standby feed pump.

" 'Tomorrow I'll have the yard mechanics put a check valve into this sampling line,' I told the Chief. 'Then you won't have this headache come up again from open valves.'

"The Chief apologized for sounding off. Soon as our full-speed trial run was over we all went to the messroom and started ballasting our cargo holds with chow. Thinking what a jackass that tiny open valve made out of me gave me a laugh. After that, I learned to suspect the smallest connections in a system as well as the biggest. Often as not, it's the little things that give the biggest headaches in a power plant.

—*SME*

Marmy's Mailbox

'Tis here you exchange blasts with the old boy

IT TAKES AN OLD CHIEF

Jittery Turbine, Nov 1955, is a masterpiece. I especially liked it because it reminded me of an experience of my own where the old chief solved an unusual problem after the hot-shot experts fooled around for months. Marmy's stories are human, helpful and eagerly read—as is his book.

J W BLAKE *New York, N. Y.*

MARMY, A FRENCH HERO?

I give a course for operating engineers and trouble-shooters in our plant. All my trainees see POWER and they've selected Marmy as their hero. So every week I take one problem from his book, *The Marmaduke Story* and read it to our trainees. He's very well liked on this side of the ocean.

P A ROUBINET *Comines, France*

MARMY, A PHILOSOPHER?

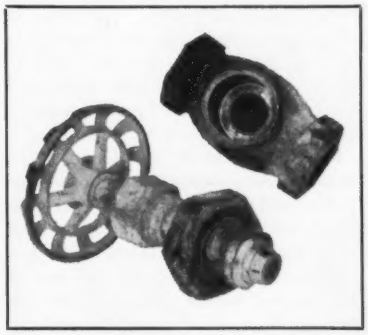
The Marmy stories remind me of this item I found in a discourse to graduating engineers by R T Allen; "One thing you're going to run up against is the old conflict between theory and practice. Experience mightn't be as important as a lot of people you'll meet think it is, but it's a lot more important than *you* think it is. Trouble with theory is that it's usually right, but it's about the wrong thing."

A C BRITTON *Sherbrooke, Que.*

"I got 5 years of service from a valve I expected to last only 90 days"

Mr. C. L. Worthington, Chief Engineer for E. L. Bruce Co., Little Rock, Arkansas plant, standing near a Walworth No. 225P Bronze Globe Valve with "500 Brinell" stainless steel seats and discs that was installed in severe boiler blowdown service. Hardened seats and discs are especially resistant to wire drawing, steam cutting, or galling.

Some time ago Mr. C. L. Worthington, Chief Engineer for E. L. Bruce Co. plant at Little Rock, Arkansas, was having valve trouble on some newly installed boilers. The first boiler to go in service generated 600 hp operating at 200-pounds pressure. The water was so bad that a hot lime and soda ash water softener treatment had to be used, and it was necessary to add other chemicals to this solution from time to time. Mr. Worthington wanted to use a continuous blowdown to skim off the worst part of the scum on the water. He installed a small blow pipe about an inch below the normal water level in the boiler. This worked well, except that the one-inch valve on the line could only be partially opened and let a small part of the scum be blown off at one time. If the valve was widely opened, it would not take long to lower the water level in the boiler and run the steam pressure down. This service gave Mr. Worthington lots of valve trouble, as can well be imagined, because of the extreme wire drawing that occurred.



A Walworth No. 225P Bronze Globe Valve that gave perfect performance for four years and 362 days in a severe boiler blowdown service where the Chief Engineer said he had never been able to keep a valve more than 60 to 90 days.

One day the Walworth representatives in that area, called upon Mr. Worthington and demonstrated the outstanding features of the Walworth No. 225P Bronze Globe Valve. This valve, which has a working steam pressure rating of 350-pounds at 550°F, has a plug-type stainless seat and disc which has been heat treated to a minimum hardness of 500 Brinell. After listening to the Walworth men and examining a 225P valve, Mr. Worthington agreed that he would try one in the severe service described. He said if it lasted 90 days, he would consider that it had done a good job.

The valve went into service and came out within three days of being in service five years under very severe operating conditions. The valve was used 24 hours a day from early in the morning on Monday until Saturday night, when it was closed until the following Monday morning. It was never opened more than three-quarters of a turn, and most of the time it was opened only one-half to one-quarter of a turn. For the life of the valve, nearly five years, it never failed to give a 100% closure when shut on Saturday night until opened Monday morning.

When another 600 hp 200-pound pressure boiler went into service, it also was equipped with a one-inch Walworth No. 225P Bronze Globe Valve on the same service.

In view of the severe service and the wire drawing to which this valve was subjected, it is interesting to note that the original valve (which was taken out of service almost five years after it had been installed) was removed – not because the seat and disc were wire drawn – but because the turbulence of the steam had finally caused a small hole to occur in the wall of the body of the valve. Needless to say, the valve that was taken out of service was replaced immediately by another one-inch Walworth No. 225P Bronze Globe Valve, positive assurance that Mr. Worthington is satisfied that this valve has "done a good job."

Other Walworth products include complete lines of Gate, Globe, Angle, Check and Lubricated Plug Valves in bronze, iron, steel, stainless steel and special alloys. Complete information and literature will be furnished upon request.

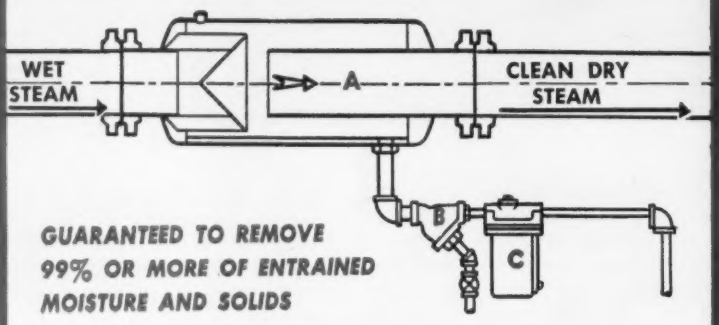
WALWORTH

60 East 42nd Street, New York 17, New York

SUBSIDIARIES: ALOYCO ALLOY STEEL PRODUCTS CO. CONOFLOW CORPORATION M&H M & H VALVE & FITTINGS CO.
SW SOUTHWEST FABRICATING & WELDING CO., INC. WALWORTH COMPANY OF CANADA, LTD.

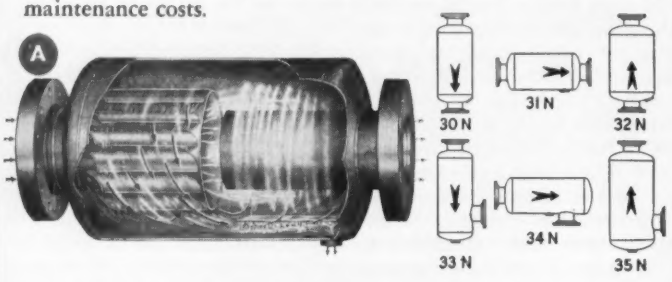
NOW—

The driest, cleanest steam available, is yours with this Wright-Austin equipment

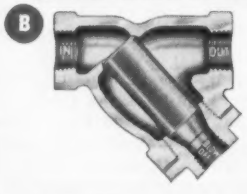


GUARANTEED TO REMOVE 99% OR MORE OF ENTRAINED MOISTURE AND SOLIDS

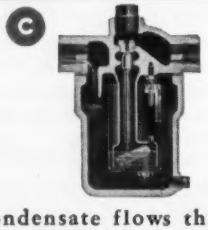
Live steam containing condensate, boiler compound, scale and other foreign matter is detrimental to equipment and is costly to super heat. These Wright-Austin accessories are engineered to give you maximum purification, resulting in lower fuel and maintenance costs.



This Wright Austin separator employs centrifugal force to remove impurities from steam, air or gas flow. The Type 31N, as well as other Models shown, are light weight, compact and sturdily constructed according to the ASME Code.



Foreign matter drains to Wright-Austin "Y" Type strainer which catches solids. These are periodically blown out by opening drain valve.



Condensate flows through strainer to Wright-Austin "Airxpel" Bucket trap. This unit automatically drains condensate as collected.

WRITE FOR NEW CIRCULAR 506-A

WRIGHT-AUSTIN COMPANY

3245 WIGHT STREET • DETROIT 7, MICH.

POWER TO GROW

Continued from page 85

an improper selection has been made. Use fuse of lower rating.

Such a silver-sand fuse installation, based on accurate data, is properly engineered and furnishes required short-circuit protection lacking in original installation. However, selection is not always made in this manner.

One operating engineer in a chemical plant found corrosive fumes had affected his circuit-breaker mechanisms and wanted to protect them with silver-sand fuses. This approach is unsound because fuses could only offer short-circuit protection. Overloads, which normally would be handled by breaker, are less than fuse rating so some other form of protection is required to correct the situation.

Here's how to tackle that problem. Either (1) replace the corroded circuit-breaker element or (2) remove breaker trip coils so breaker will not try to open on faults. In latter case, use dual-element fuses to protect over entire current range.

Silver-sand fuses are used in protecting existing circuits having protective devices with inadequate interrupting ratings in addition to new installations. In latter case silver-sand fuses limit short-circuit currents so you can (1) use smaller, cheaper components (2) give more positive fault isolation.

Using the fuse for short-circuit protection assures that future growth of the system will not increase the available currents to a dangerous point. Hence, there is a great deal of merit in such a combination. However, in some cases, selection is made merely to save on the cost of the job. And to further reduce cost, a single silver-sand fuse is often installed to protect a group of circuit-breakers.

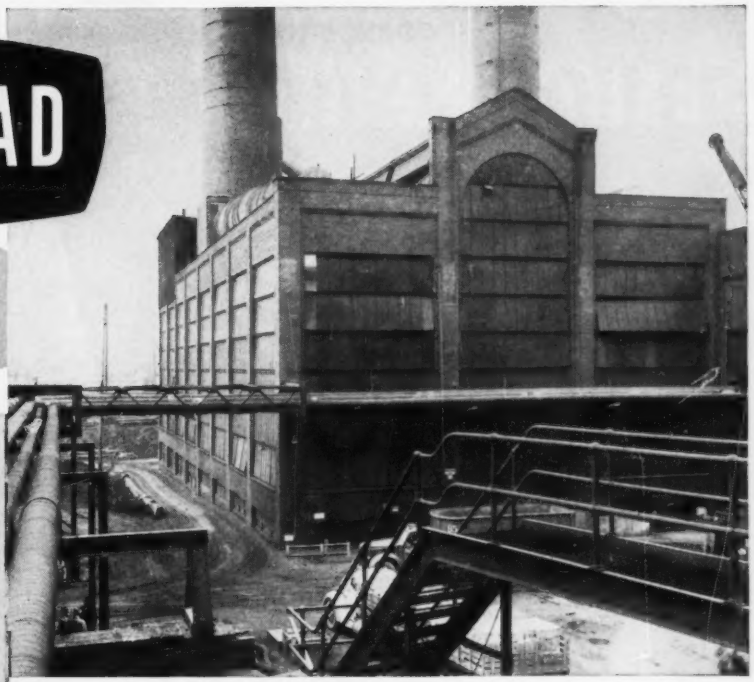
Practical example was found in an office building where a group of ten 15-amp molded-case breakers were protected with one 200-amp silver-sand fuse. Installation certainly was low cost but a short-circuit on any one of the 15-amp branch circuits blew the 200-amp fuse, shut down all ten circuits. Such an installation is completely lacking in fault isolation. So, original money saved was spent many times over on system maintenance.

A more reasonable application of silver-sand fuses in a new installation is where the fuses are used for fault isolation and, by means of special blades, fuses also serve as a disconnect. A bank of nine such 3-phase panels connect directly to the transformer and feed nine different parts of the plant. Each part can be de-energized by removing the fuses after dropping the

OVERHEAD

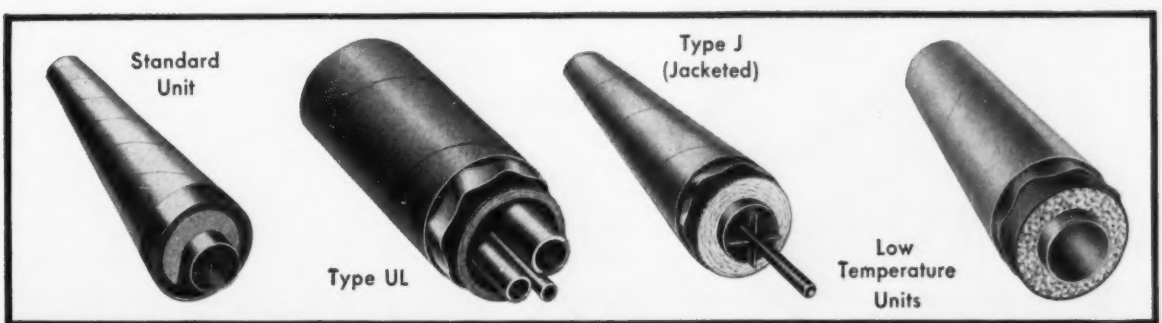
OR

underground



Ric-wiL offers the COMPLETE quality line of prefabricated piping systems

Ric-wiL factory prefabricated piping systems, *timed* to your schedule and *shipped* directly to the job site, can save you valuable time and money. Insulated units are available for steam, hot water, oil, other viscous fluids, process liquids and refrigeration lines . . . and remember . . . Ric-wiL is the quality system of exceptionally high mechanical strength and thermal efficiency.



Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency

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BARBERTON, OHIO

IN CANADA: THE RIC-WIL COMPANY OF CANADA LIMITED

Write for a copy of the new Ric-wiL Catalog . . .

POWER TO GROW

Continued from page 210

load. Since the plant atmosphere contains much dust, the short-circuit possibilities are greater. This further justifies use of silver-sand fuses.

Briefly, properly applied silver-sand fuses furnish a high degree of current limitation on short-circuit. They have definite applications where this is the sole function required. Silver-sand fuse is a valuable addition to the line of low-voltage fuses. In any new design the advantages of all types of protection must be weighed and the proper type selected.

More FREE LITERATURE

Begins on page 171

10 **Relays and switches.** Illustrated 12-p bulletin shows about 40 different switches and relays, ranging from standard size units to miniature. Describes operation and characteristics of each. The Jaidinger Mfg Co Inc, 1921 W Hubbard St, Chicago 22, Ill.

ELECTRICAL EQUIPMENT

11 **Electric power drives.** Illustrated 20-p bulletin includes selection data on normal speed electric motors, geared motors, variable speed transmissions and speed reducers. Sterling Electric Motors, Inc, 5401 Telegraph Rd, Los Angeles 22, Calif.

12 **Dripproof enclosed motors,** *Tri-Clad 55,* are subject of 12-p bulletin GEA-5980. Illustrates production testing techniques and construction features of motors in 1 to 5 hp range. General Electric Company, Schenectady 5, N. Y.

13 **Rerated motors.** Illustrated 8-p bulletin 520 features *Series 254-U* all-weather, corrosion-resistant motors. Robbins & Myers, Inc, Springfield, Ohio.

14 **Motor selector** bulletin B-2103-1 gives full information on how to select ac motors for specific applications. Includes photos, charts, tables. Reliance Electric and Engineering Co, 1088 Ivanhoe Rd, Cleveland 10, Ohio.

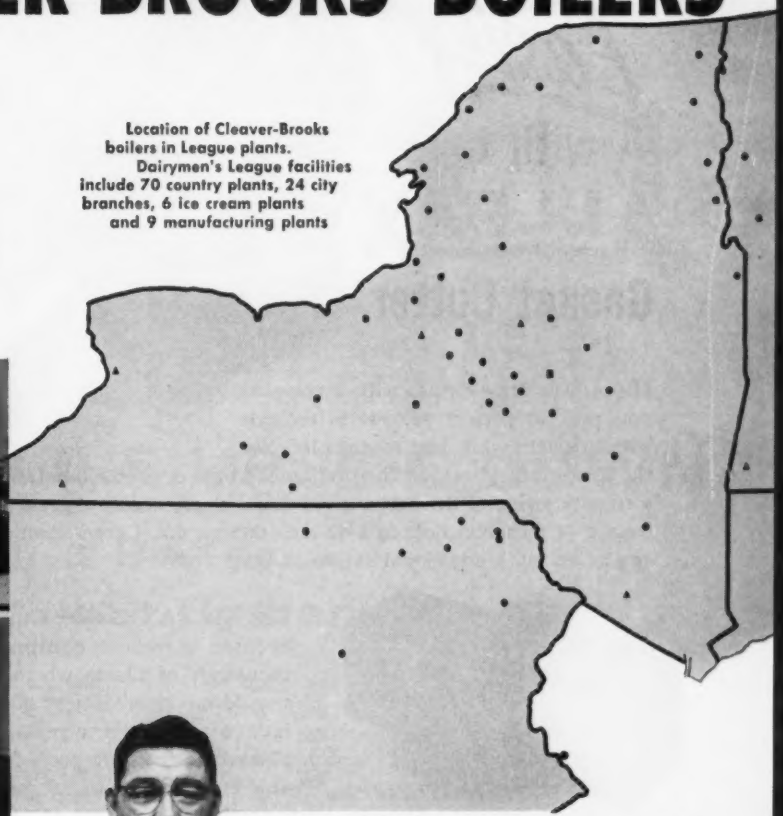
15 **Trolley busway system** is the subject of 4-p bulletin 56A. Contains photos of major components and describes advantages of the system. Electric Service Works, Delta-Star Electric Division, H K Porter Company, Inc, 17th and Cambria Sts, Philadelphia 32, Pa.

16 **Circuit breakers.** A method of coordinating molded-case circuit breakers with current-limiting fuses for protecting low-voltage feeder circuits against fault currents up to 100,000 amp is de-

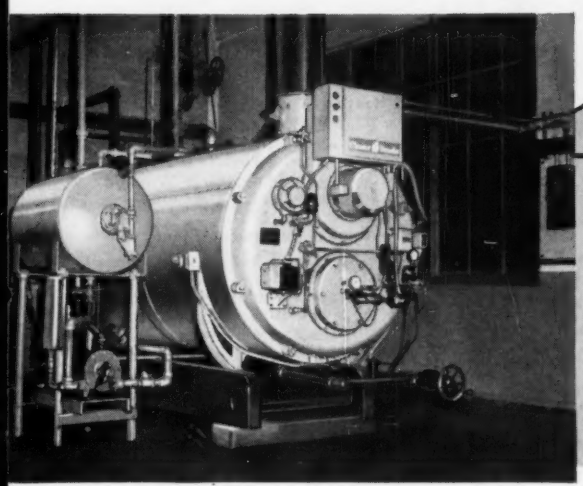
One of America's largest and leading dairy associations uses

69 CLEAVER-BROOKS BOILERS

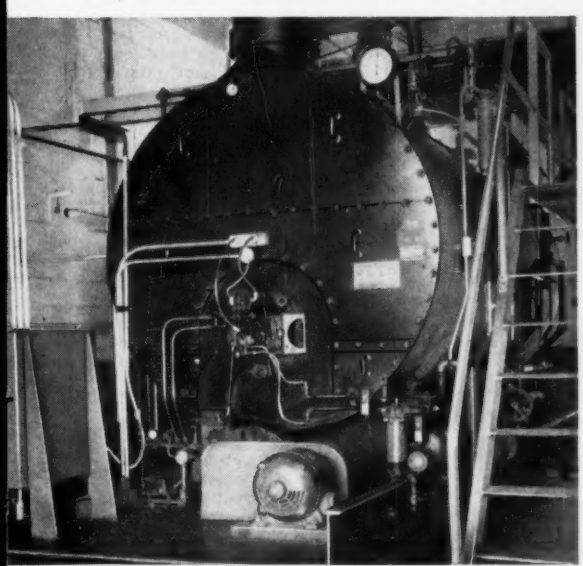
SEE OUR EXHIBIT
BOOTH NOS. 648-650
INTERNATIONAL HEATING & AIR CONDITIONING EXPOSITION
CHICAGO
FEB. 25 — MARCH 1



Location of Cleaver-Brooks boilers in League plants. Dairymen's League facilities include 70 country plants, 24 city branches, 6 ice cream plants and 9 manufacturing plants



MILTON, PA. — This country plant is supplied with quick, dry steam from a Cleaver-Brooks 60 hp light-oil fired CB boiler.



UTICA, N.Y. — In this city plant a 250 hp LR heavy-oil fired boiler provides all steam for pasteurizing, cleaning, heating and processing.

"Our 69 Cleaver-Brooks boilers are a key part of our production — their unusually high efficiency, sanitary, clean operation have helped us grow and prosper", says Ken Dodge, staff engineer for Dairymen's League Cooperative Association.

"Maintenance is low. We average far less than one service call per boiler per year," he adds.

Dairymen's League Cooperative Association, serving 25,000 dairy farmers and thousands of consumers in New York, Pennsylvania and New Jersey, has been a steady user of Cleaver-Brooks boilers for 20 years.

Like any dairy company, the League finds steam essential for the production of quality dairy products. Their boilers are the work horses of their plants — supplying steam for pasteurizing, heating, cleaning and processing.

And Cleaver-Brooks boilers, with their exclusive four-pass, forced draft design and clean, quiet operation are especially suited to dairy plant operation.

Famous dairies the country over are profiting with the many advantages of Cleaver-Brooks boilers, available in a complete line. You can select from 110 models in 18 boiler sizes, 15 through 600 hp . . . oil, gas and combination oil and gas fired.

For more information contact your nearby Cleaver-Brooks representative. Or write Cleaver-Brooks Company, Dept. A, 301 E Keefe Avenue, Milwaukee 12, Wis. Cable Address: CLEBRO — Milwaukee — all codes.

Cleaver Brooks

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If you can draw circles with a compass you can cut perfect gaskets in seconds with this handy kit. Just set the blade for the desired thickness, set the pivot post at the desired diameter, and a smooth swing of the cutter gives you a clean, accurate gasket . . . from a ¼ inch bolt hole to a 60 inch outside cut. Larger diameters can be cut with additional extension arms.

ALLPAX Gasket Cutter is packaged in this strong steel case.

The ALLPAX Gasket Cutter has become standard equipment in thousands of plants where expensive "down time" is kept at a minimum by cutting new gaskets when and where they are needed. Available in five styles to cut maximum diameters of 12, 24, 36, 48, 60 inches.

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400—Compressed Asbestos Sheet
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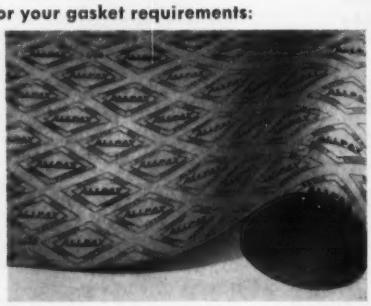
750—Black Rubber Sheet
800—Diaphragm Sheet
850—Cloth-Inserted Sheet



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More FREE LITERATURE

Begins on page 171

scribed in bulletin GEA-6569. Circuit Protective Devices Dept, General Electric Company, Plainville, Conn.

17 **Convertors.** Illustrated 12-p bulletin 50 covers U-tube steam to water convertors. Contains photos, capacity tables, selection charts. Davis Engineering Corporation, 1064 E Grand St, Elizabeth, N. J.

18 **Recuperators.** Illustrated 4-p bulletin contains data on metallic recuperators and finned recuperator tubes. Brown Fintube Company, Box 520, Elyria, Ohio.

SAFETY EQUIPMENT

19 **Magnetic shielding.** Illustrated 33-p technical brochure entitled "Data Sheets 101 (1957)" describes construction features, performance characteristics and typical applications of non-shock sensitive nonretentive Fernetic and Co-Netic magnetic shielding material. Magnetic Shield Division, Perfection Mica Company, 20 N Wacker Dr, Chicago 6, Ill.

20 **"Prescribed lighting** protects the eyes of industry" is title of 28-p bulletin. Features sections on safety and visibility factors, standards for use in prescribing plant lighting, uses of fluorescent, incandescent and mercury vapor lamps; lighting of other areas, maintenance and condensed catalog data on fixtures. Sylvania Electric Products Inc, Wheeling, W. Va.

MAINTENANCE EQUIPMENT

21 **Inorganic zinc coating** for structural steel, tank interiors and exteriors, towers and equipment is described as to general, physical and chemical properties in 4-p bulletin. Amercoat Corporation, 4809 Firestone Blvd, South Gate, Calif.

22 **Cold galvanizing compound** that rustproofs iron and steel surfaces, prevents corrosion at welded joints and repairs damaged galvanized surfaces is illustrated and described in 4-p bulletin 5610. American Solder & Flux Co, 19th & Willard Sts, Philadelphia 40, Pa.

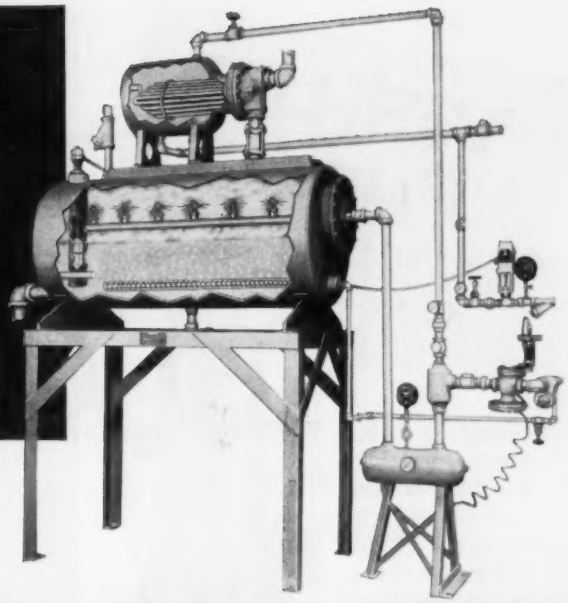
23 **Blast-cleaning abrasives.** Illustrated 12-p bulletin 333 presents characteristics, application and selection data. Pangborn Corporation, Hagerstown, Md.

24 **Aluminum jacketing** for insulating tanks, vessels and piping systems is described in 40-p bulletin. Gives complete recommendations for selecting, fabricating and installing various aluminum jacketing components. Kaiser Aluminum & Chemical Sales, Inc, Process Industries Dept, PR-1256, 1924 Broadway, Oakland 12, Calif.

(*Continued on page 216*)

SCHAUB

ZERO-OXYGEN DEAERATOR



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Comes Up with a Better, Simpler Deaeration System

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THE RESULT: An entirely new and simpler kind of boiler feedwater deaerator that insures complete oxygen removal (to .005 cc/liter) under all conditions and wide load variations—with excellent thermal economy. Add to this, lowest maintenance, plus complete safety and utmost dependability.

Basic differences that give Schaub Zero-Oxygen Deaerators their more effective performance are: 1) *external pre-heating* to a temperature *well above* boiling point within the deaerator; 2) explosive flash-down release of dissolved gases; 3) *unrestricted venting* through a special type vent condenser for faster *complete* release of liberated gases, without wasteful excess steam vapor losses.

By delivering *superheated* water into the fully vented tank, the hitherto critical problem of "matching" temperature to the *"full"* boiling point at the pressure within the deaerator is entirely eliminated. (This has been a major stumbling block with conventional deaerator design.) Passing through multiple, specially designed spray nozzles, incoming water "flashes down" in an explosive action that effectively liberates oxygen, CO_2 and all other non-condensible gases.

Also with unrestricted venting there is no need for premium-cost pressure shell. No pressure relief valve, overflow trap or orifice adjustment is ever required. Rust-proof Chromosoid lining insures extra-long life.

Before you plan any installation or addition of deaerating capacity get the full facts on all the performance advantages proved by the Schaub method. Ask your Schaub representative, or write for Bulletin 575.

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More FREE LITERATURE

Begins on page 171

25 **Protective coatings.** Four types of coating to meet every temperature condition are discussed in 4-p bulletin MPC 25-956. Contains data on applications, how to apply, temperature range, coverage. Markal Co, 3052 W Carroll Ave, Chicago 12, Ill.

METERS AND INSTRUMENTS

26 **Rotameters,** versatile instruments for the accurate measurement of fluid rate of flow, are described in 12-p bulletin 18RG. Gives data on application, construction, operation and installation. Schutte and Koerting Company, Dept M-E, Cornwells Heights, Bucks County, Pa.

27 **Meters** for factory, field and laboratory use are described in 8-p bulletin. Includes charts, diagrams, photos. Greibach Instruments Corporation, Metuchen, N. J.

28 **Portable dc hypots** are subject of bulletin 14-2. Included are data sheets covering latest models that have output voltage ranges of 0-70,000 VDC. Associated Research Inc, 3770 W Belmont Ave, Chicago 18, Ill.

29 **Temperature controllers.** Illustrated brochure MC-139 gives complete specs on series of bulb-and-capillary indicating temperature controllers. Fenwal Inc, Ashland, Mass.

30 **Annunciator systems** are subject of 32-p catalog 100B. Fully illustrated. Panellit, Inc, 7401 N Hamlin Ave, Skokie, Ill.

31 **Annunciator systems** are described in 20-p illustrated catalog. Contains complete selection data. Scam Instrument Corporation, 1811 W Irving Park Rd, Chicago 13, Ill.

32 **Pressure gages,** for use on such services as engines, turbines, blowers, pumps and compressors, are described in 4-p bulletin DH-23. Helicoid Gage Division, American Chain & Cable Co, Inc, Bridgeport 2, Conn.

33 **Process control** instrumentation for indicating, recording, controlling and transmitting flow, pressure, density, chlorination, is fully discussed in 32-p bulletin 2. Fischer & Porter Co, 907 Jacksonville Rd, Hatboro, Pa.

PIPING, VALVES, FITTINGS

34 **Piping systems,** prefabricated, insulated, for steam, condensate, hot or chilled water and other fluids, are described in 28-p bulletin 100. Gives data on design, applications, installation. E B Kaiser Co, 2114 W Lake Ave, Glenview, Ill.

35 **Underground conduit systems.** Illustrated 4-p bulletin SW-256-25

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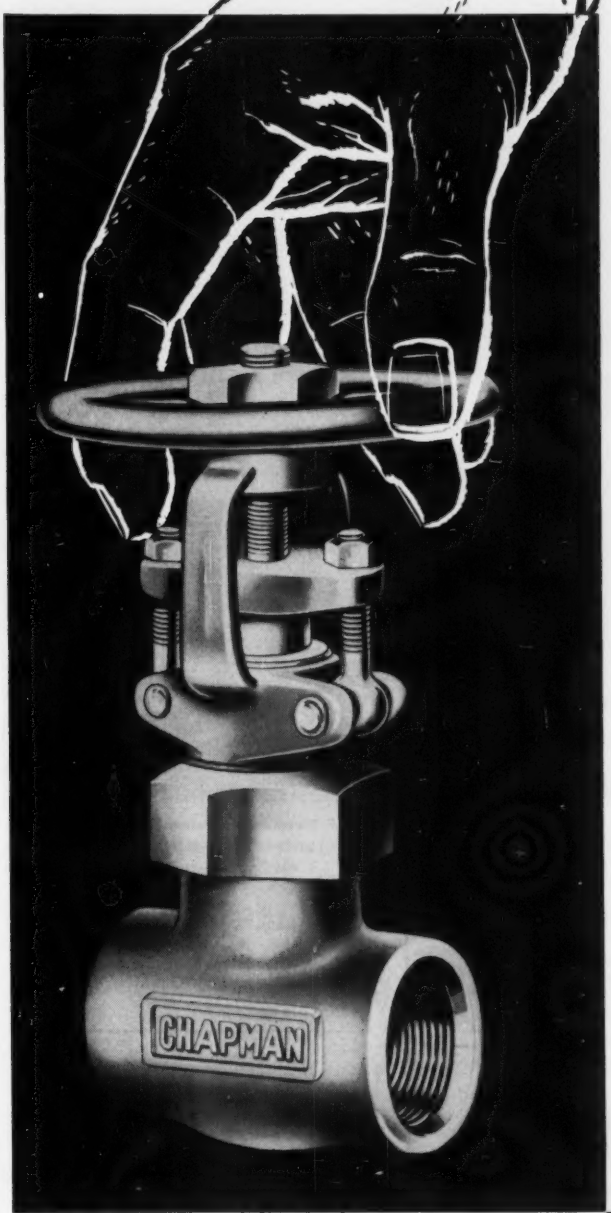

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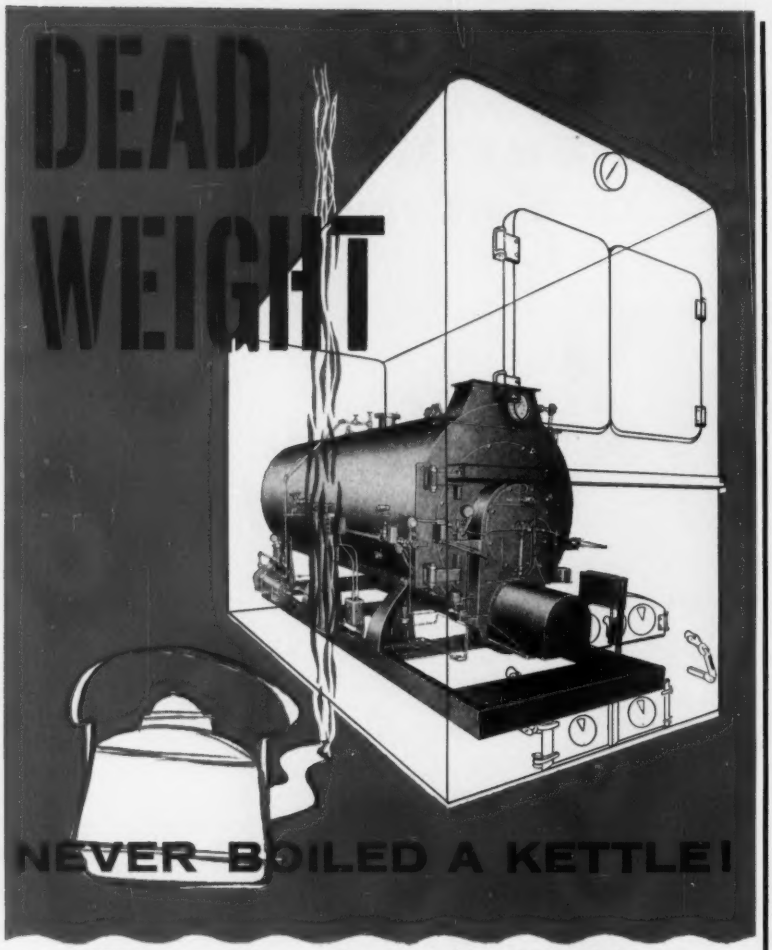

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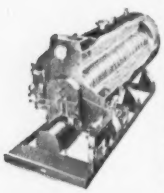

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More FREE LITERATURE

Begins on page 171

contains suggested specs, complete descriptive information. Stillwater Clay Products Co, 3334 Prospect Ave, Cleveland 15, Ohio.

36 **Unplasticized pvc pipe,** fittings and valves are described in 16-p bulletin. Contents include physical properties, chemical resistance tables, dimensions, flow rate charts. Colonial Plastics Mfg Co, 2685 E 79th St, Cleveland 4, Ohio.

37 **Forged steel unions** for high-pressure service are discussed in illustrated 8-p bulletin U-1-56. W-S Fittings Division, H K Porter Co, Inc, Box 95, Roselle, N. J.

38 **Diaphragm control valve** provides accurate pressure reduction and regulation of steam, water, air, oil, brine and most liquids and gases. Illustrated 4-p bulletin 980 gives specs, capacities. A W Cash Co, Box 551, Decatur, Ill.

39 **Control valves.** Illustrated 12-p bulletin gives details on construction and operating characteristics of *Series LB* valves, available in sizes 1 through 4 in. Conoflow Corporation, 2100 Arch St, Philadelphia 3, Pa.

40 **Lubricated plug valves.** Illustrated 28-p catalog 39-5 shows 100% pipe area, venturi, round port, and diamond port units in a variety of metals for 150 lb steam working pressure. Homestead Valve Mfg Co, Coraopolis, Pa.

41 **Diaphragm valves** and metering and proportioning pumps are subject of 16-p illustrated catalog G-56. Includes specs on valves, tables of capacities on pumps. Hills-McCanna Co, 2369 W Nelson St, Chicago, Ill.

★ **Expansion joints,** packless corrugated, are described in 72 p illustrated bulletin 56. Covers three types. Contains over 150 photos, line drawings and schematic diagrams. Tables and charts give full specs. ★Request direct on company letterhead from Zallea Brothers, 895 Locust St, Wilmington 99, Delaware.

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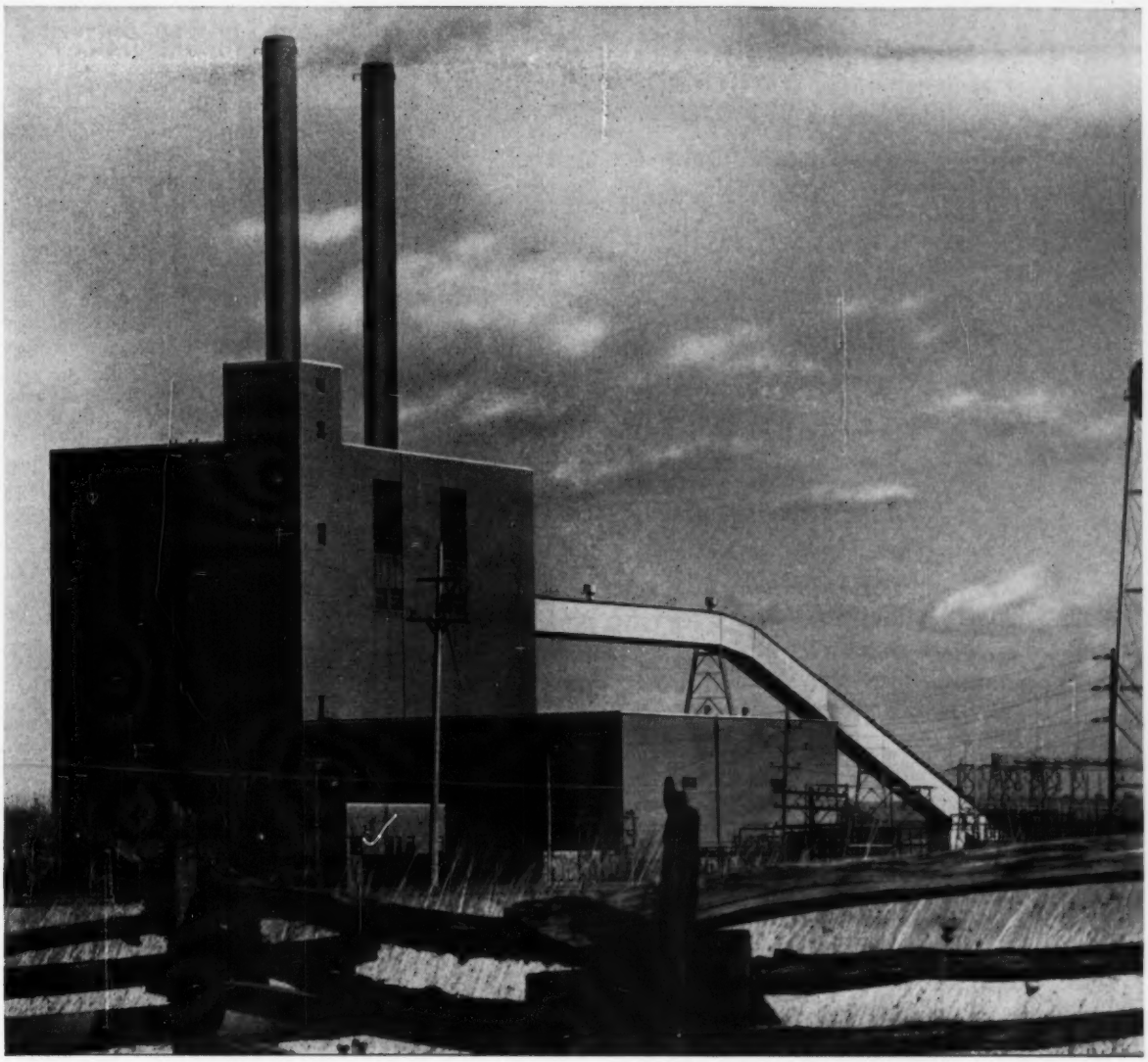

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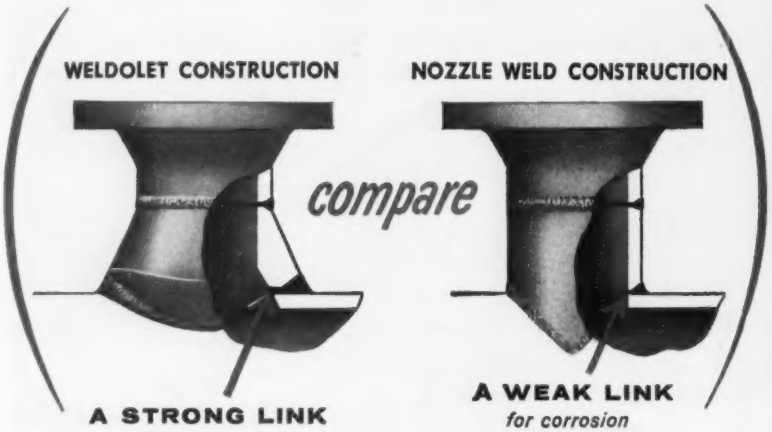

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More TECHNICAL BRIEFS

Begins on page 158

value of conductivity, distribution of corrosion follows that of conductivity, the logarithm of which is normally distributed. Here use is made of modern mathematical statistics to relate maximum corrosion to the area associated therewith. A similar analysis relates maximum corrosion to pit depth. Introduction of the pipe's wall thickness into the analysis completes the development whereby the trend of leaks on pipelines may be traced.

Importance of effort lies not only in the success attained in the accounting but the novel and practical conclusions that have resulted. The complete work is regarded as a substantial contribution to the theory of underground corrosion. *NACE paper No. 29.*

Resources

Potential resources of mineral coal for future generation in Mexico. *By Ing Luis F de Anda, Geothermic Power Commission.*

The coal deposits in Mexico are estimated at 2907 million tons; 1690 million tons are located in North Mexico, the remainder is distributed in other parts of the country. Up to now, coal has been produced in only one district; the quantity of coal supplied in 1954 was about 2 million tons; import is insignificant. The unimportant output of coal is caused by the strong competition of petroleum.

Coke production reached about 600,000 tons in 1952; 80 to 90% of the coke consumed in Mexico was supplied by one plant. Coke is used mostly by the metallurgical industry. *WPC paper No. 158A24.*

The state and development of power production and utilization in Mexico. *By Ing Luis F de Anda, Geothermic Power Commission.*

The development of power production and utilization in Mexico is marked by three distinct periods: until 1926 it lacked legal control; from 1926 to 1933, the federal government issued several decrees and ordinances, and finally, from 1933, the federal congress enacted bills regulating power production and utilization.

The paper gives information on the growth of the population, labor and national income. It lists the national supply companies and distribution systems as well as the number of power stations and their capacities. It deals with the problems of electricity sale,

(*Continued on page* 222)

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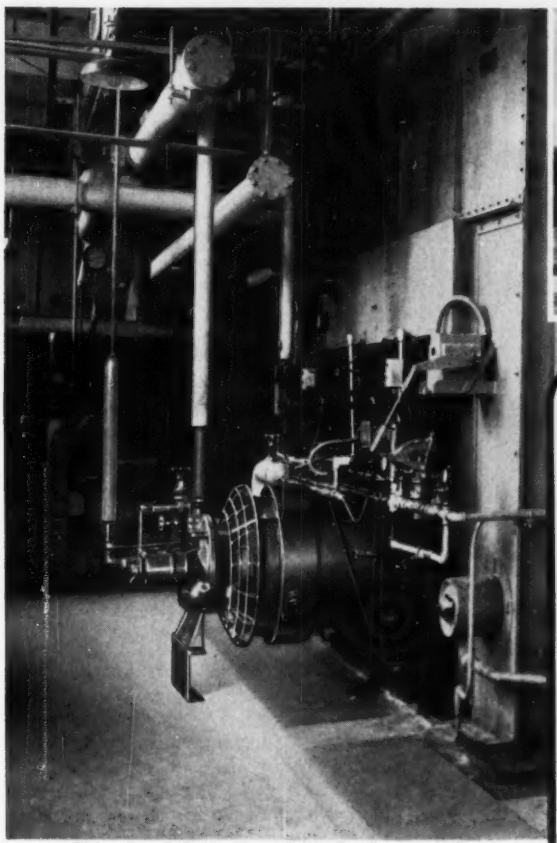
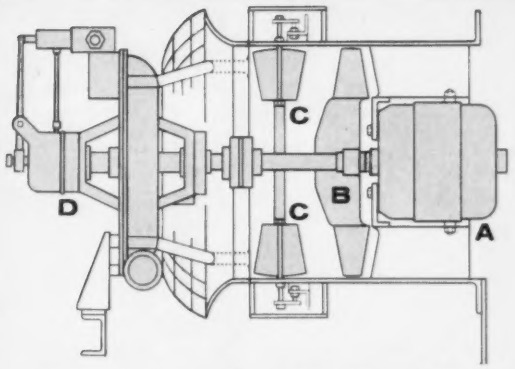
WING DUAL DRIVE FORCED DRAFT BLOWERS



Wing Dual Drive Forced Draft Blower at the Easton, Pa. plant of the Dixie Cup Company.



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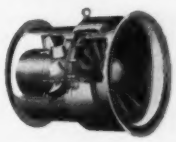

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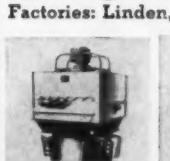

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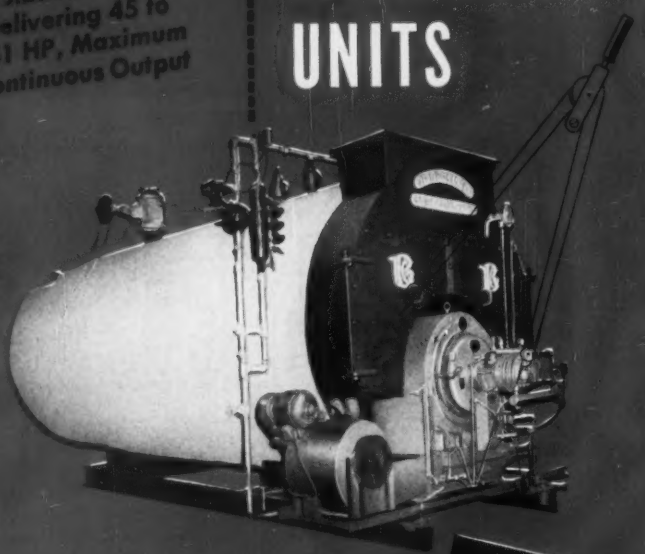

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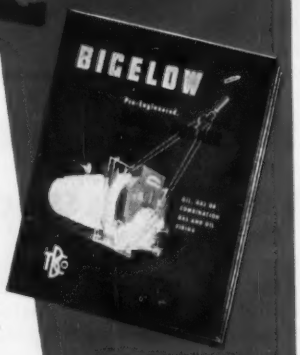

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BI-17

More TECHNICAL BRIEFS

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netted proceeds, tariffs and financing. Finally, the paper includes characteristic figures and data on the employment status, various organizations, contractual relations, as well as information on compilation methods for statistical data. *WPC paper No. 157A23.*

Outline of the extent of energy resources of the Republic of Uruguay, proved and probable. *By The Uruguayan National Committee.*

This paper outlines the energy resources of the Republic of Uruguay, which are essentially of an hydraulic nature. The main characteristics of the existent and projected hydro power plants on the Negro River are briefly detailed; these make up the most important group of plants in the country. Some information is included in reference to the projected hydro plant on the Uruguay River near Salto Grande. Some other hydro plants of lesser importance are also considered.

The hydrological and topographical characteristics of the utilization of hydroelectric resources in Uruguay are briefly studied. The existence of peat deposits in Uruguay is mentioned and some relative data are given, as well as information on the initial drilling on a large scale for oil prospecting. *WPC paper No. 149A21.*

Production and use of energy in Finland: development since 1950 and prospects of the future. *By Bror Nordovist, Electrical Department of Ekono.*

The author first gives a short survey of energy consumption in Finland, based on statistical data. He goes back to 1928 for the sake of continuity and underlines the fact that the natural fuel resources of Finland are wood and peat. There are no mineral fuels, as far as is known. The electrical energy supply has, up to now, been based chiefly on the utilization of hydropower. In the second part, a forecast of the increase of power and fuel demand is presented. The forecast is clarified by two diagrams.

The third part of the paper deals rather extensively with the domestic energy resources of the country and the possibilities of utilizing them. Providing that the plans for construction of new hydro-power plants are efficiently realized, there will be, according to the forecast, sufficient hydro power for meeting the increased power demands as calculated 10-12 years in advance. *WPC paper No. 51A11.*

(*Continued on page* 225)

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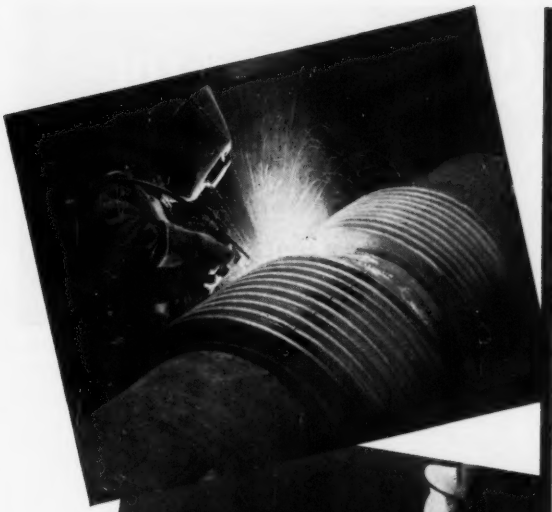

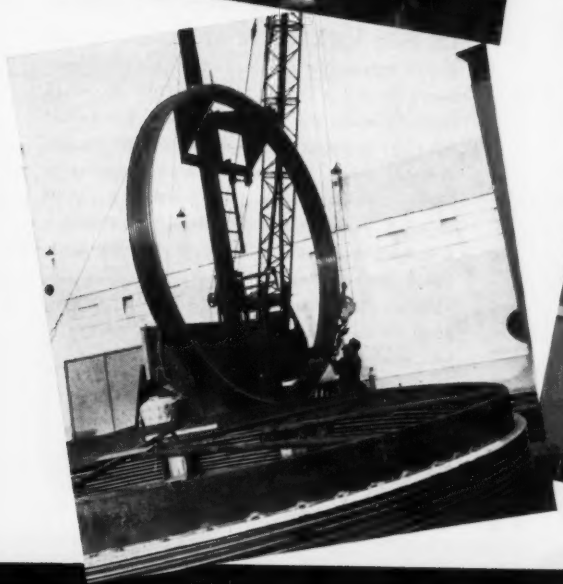

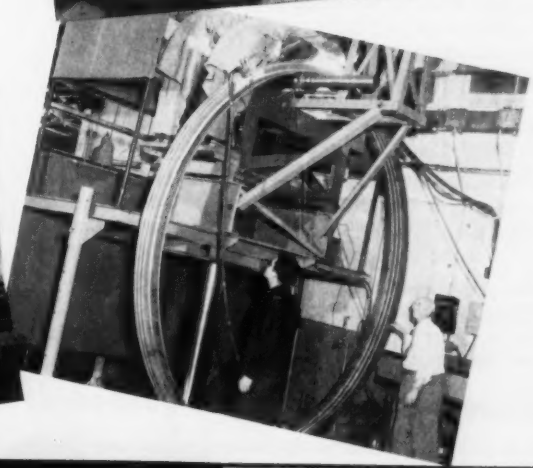

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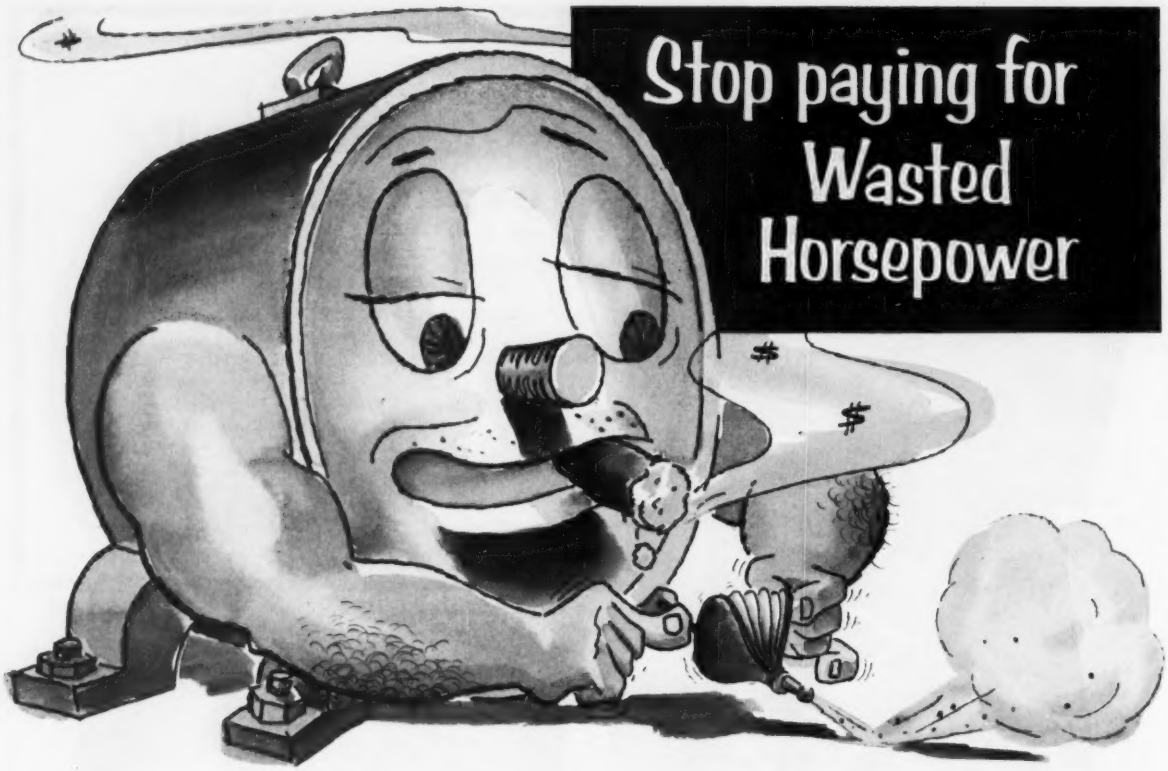

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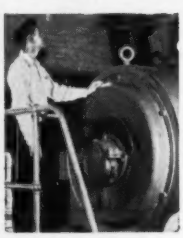

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More TECHNICAL BRIEFS

Begins on page 158

Recent progress (since 1950) achieved in the developments of hydro and thermal resources of electric energy in Turkey. *By T Fikret Suer, Ministry of Public Works.*

The Turkish Republic, part of the former Ottoman Empire which once extended into the continents of Europe, Asia and Africa, at present covers an area of 777,000 km^2 and has a population of 22,461,000. As regards conditions of climate and terrain, Turkey may be divided into several different zones.

Turkey has more than 20 mountains with more than 3000 m height each. Snow begins to fall late in the autumn, rests on the high mountains during winter and starts to melt only at the end of spring. The rivers Firat, Dicle, Coruh and Kizilirmak receive huge quantities of water from the melted snow. Therefore Turkey has a very large potential source of hydraulic energy.

Although investigations of this hydraulic potential are not yet completed, estimates by the Office of Electric Research have given the output by hydraulic plants, which could be constructed easily, as 3 million kw. Their annual generation capacity would be 15 billion kwhr. Without doubt, these figures could be increased considerably after more research work. *WPC paper No. 46A9.*

Japan's energy resources, present and future. *By Dr. Koichi Aki, Prime Minister's Office.*

With progressive industrialization, Japan's energy consumption has increased remarkably. The population totalled 88 million in 1954, and the nation produced 42,720,000 metric tons of coal, 340,000 kiloliters of oil, 140,000,000 cubic meters of natural gas, 22,000,000 metric tons of fuelwood, and 59,600,000,000 kilowatt hours (of which 45,300,000,000 kwhr was hydro power) of electricity. The country imported 3,450,000 metric tons of coal and 10,400,000 kiloliters of oil. Thus the total energy consumed last year is calculated to be 92,920,000 metric tons in terms of coal equivalent.

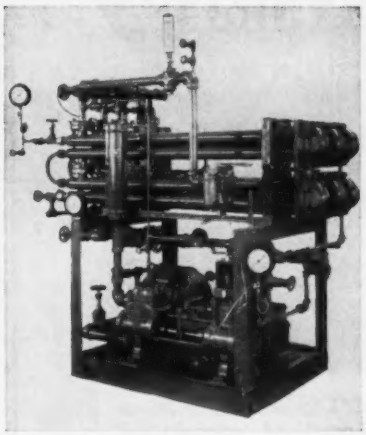
It is calculated that the energy demand in 1975 will reach about 200 million metric tons in terms of coal. On the other hand, the maximum economic energy supply at that time is estimated at about 150 million metric tons in terms of coal. *WPC paper No. 38A7.*

(*Continued on page 226*)

Directions for ordering papers on page 228

LOCKETT FUEL OIL PUMPING AND HEATING SETS

Custom Built



A composite Pump and Heater Set, consisting of one Steam-Driven Duplex Pump and one Electric-Driven Rotary Pump, with Heater Units mounted above the Pumps. Complete with Pressure and Temperature Controls. Capacity 4,000 pounds per hour of bunker C fuel oil against 300 P.S.I.

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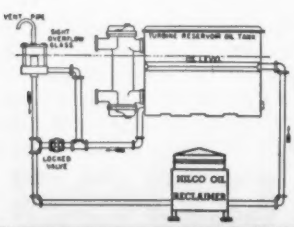
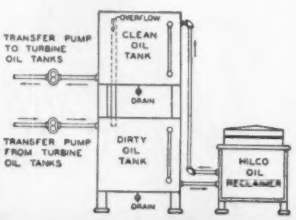
The HILCO Turbine Oil Reclaimer is a self-contained, compact unit that will produce and maintain oil free of all solids, sludge, acids, moisture and air, keeping the oil in first class condition. Its purifying process is a continuous, all electric, automatic operation, requiring infrequent attention. It removes contaminants as fast as they are formed, maintaining lubricating oil at full value of new oil. HILCO Oil Reclaimers will also purify compressor, hydraulic, insulating, Diesel and gas engine lube oils.

Purifies Turbine Oil by Continuous or Batch Purification . . .





A continuous, direct-connected, sealproof oil reclaiming system. Oil flows from turbine reservoir tank to sight overflow glass, to HILCO Oil Reclaimer, and back to reservoir.

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More TECHNICAL BRIEFS

Begins on page 158

The state and development of electric power production in Japan. *By Takashi Fujii, Economic Planning Board.*

Japan's energy supply is being derived mainly from its hydro power potential of 22,335 mw (of which some 14,000 mw is undeveloped), and its coal reserves of about 18.6 billion tons. Thus, the country has established a joint system of power supply in which hydro power plants are mainly supplemented by thermal plants.

After the war, a severe power shortage was experienced due mainly to the stagnation in constructing electric power plants. Development was, however, resumed in or around 1951. Accordingly, the power supply situation became favorable after 1953 with an enforcement power plant building at an average rate of about 1 million kw a year. At present, the Government is carrying out a 5-year power development plan aiming at achieving about 4600 mw new capacity by 1958. In 1954, plants for 990 mw were completed, and a total of 3778 mw capacity, of which 797 mw was newly added, is under construction in 1955. *WPC paper No. 32A5.*

Progress in the development of the energy resources of Canada. *By Department of Northern Affairs and National Resources, and Dominion Coal Board.*

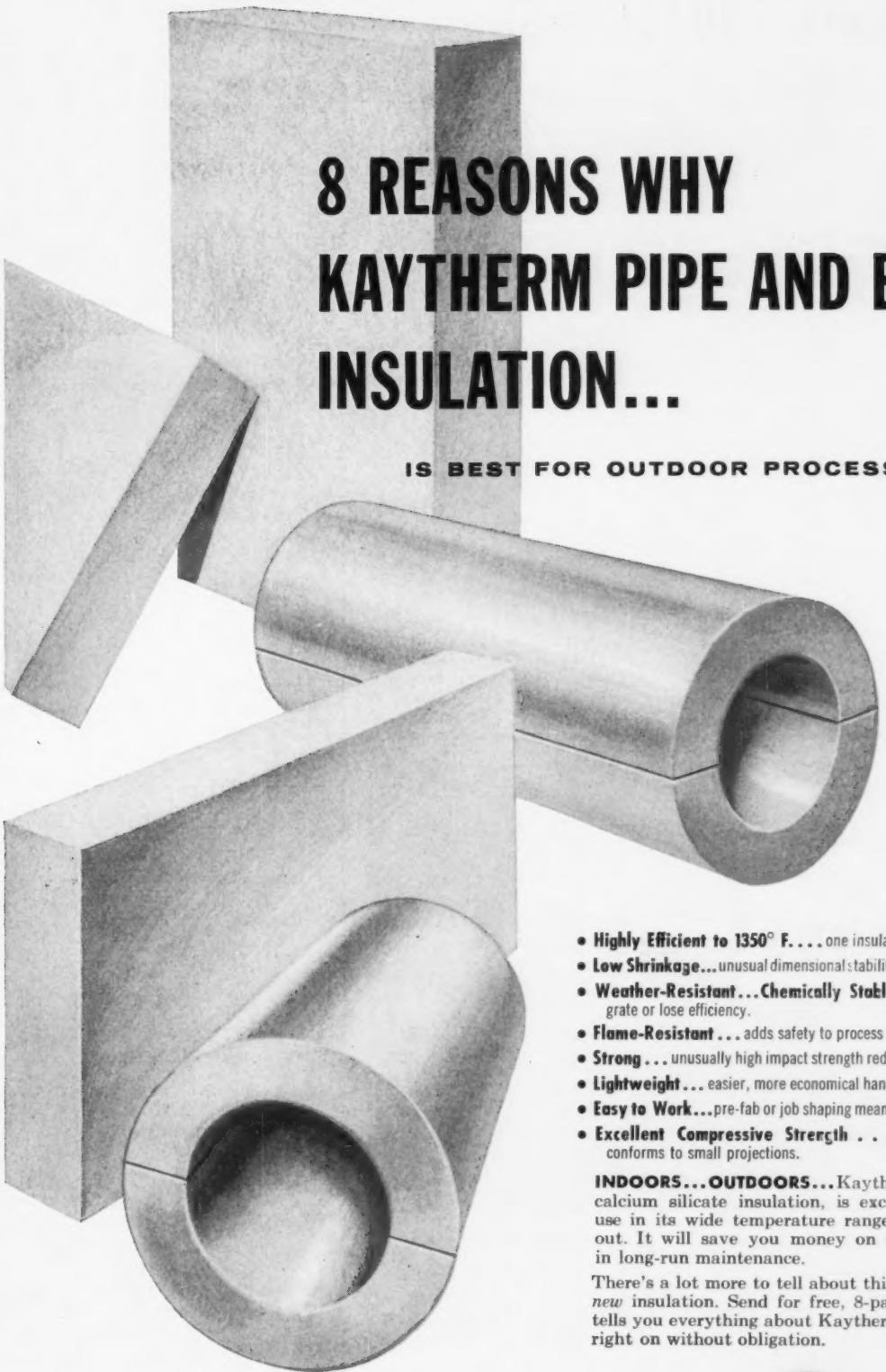
This paper briefly reviews the growth in the development of the energy resources of Canada under headings of water power, coal, oil, natural gas, wood and atomic energy. It notes the large increases in hydroelectric installations across the country since 1948, the increases in oil and natural gas reserves and the impact of the expanding utilization of these energy resources on the development of coal reserves. It refers to the expansion in energy resources through new finds of fissional ores and notes the efforts going forward to make this atomic energy available for peaceful uses. Based on past demands and present growth, future energy requirements are indicated. *WPC paper No. 181A31.*

Pumps

Hydraulic transients in centrifugal pump systems. *By C P Kettredge, Princeton University.*

Differential equations of motion for rotating parts of the pump and prime

Directions for ordering papers on page 228



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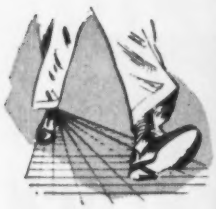

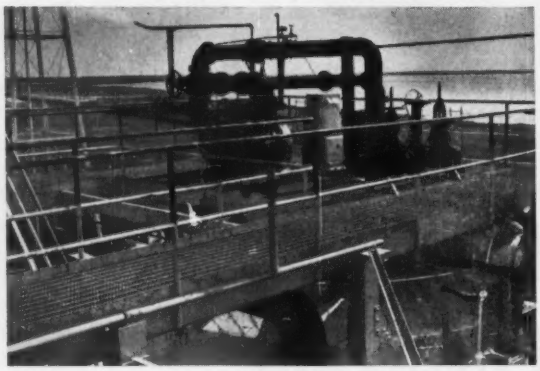

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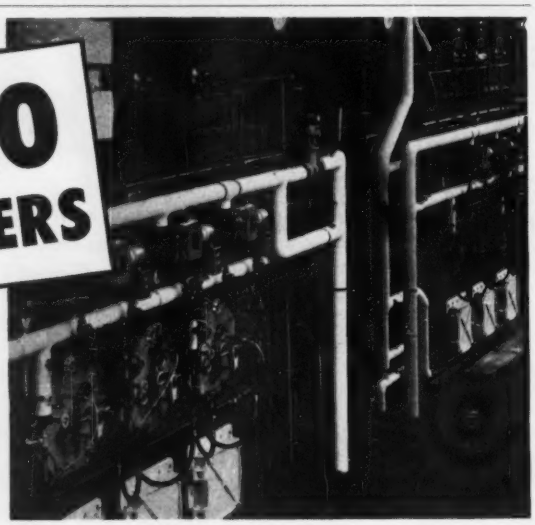

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More TECHNICAL BRIEFS

Begins on page 158

mover, and fluid in the pipe, are derived in this paper. Methods of integrating the equations are discussed for the case of an assumed rigid fluid column and for the elastic fluid column. A hitherto unpublished solution for the elastic-column problem is described. Complete characteristic diagrams for several pumps are given Solutions by different methods are compared and examples for actual installations shown. *ASME paper No. 55-A-72.*

Suppression of pump vibrations set up at starting up—preopening method. *By Prof F Numachi, Institute of High Speed Mechanics, Tohoku University, Japan.*

Cases occur in large water pumps where, after installation, vibrations exceeding allowable limits develop during the start-up period. To meet such situations without reconstructing the pump, a method of preopening delivery valves while the pump is coming up to speed is presented.

The paper explains the means of estimating the reverse-flow quantity, torque required and the time to reach normal speed. An example of application to actual practice is also given. *ASME paper No. 55-A-145.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

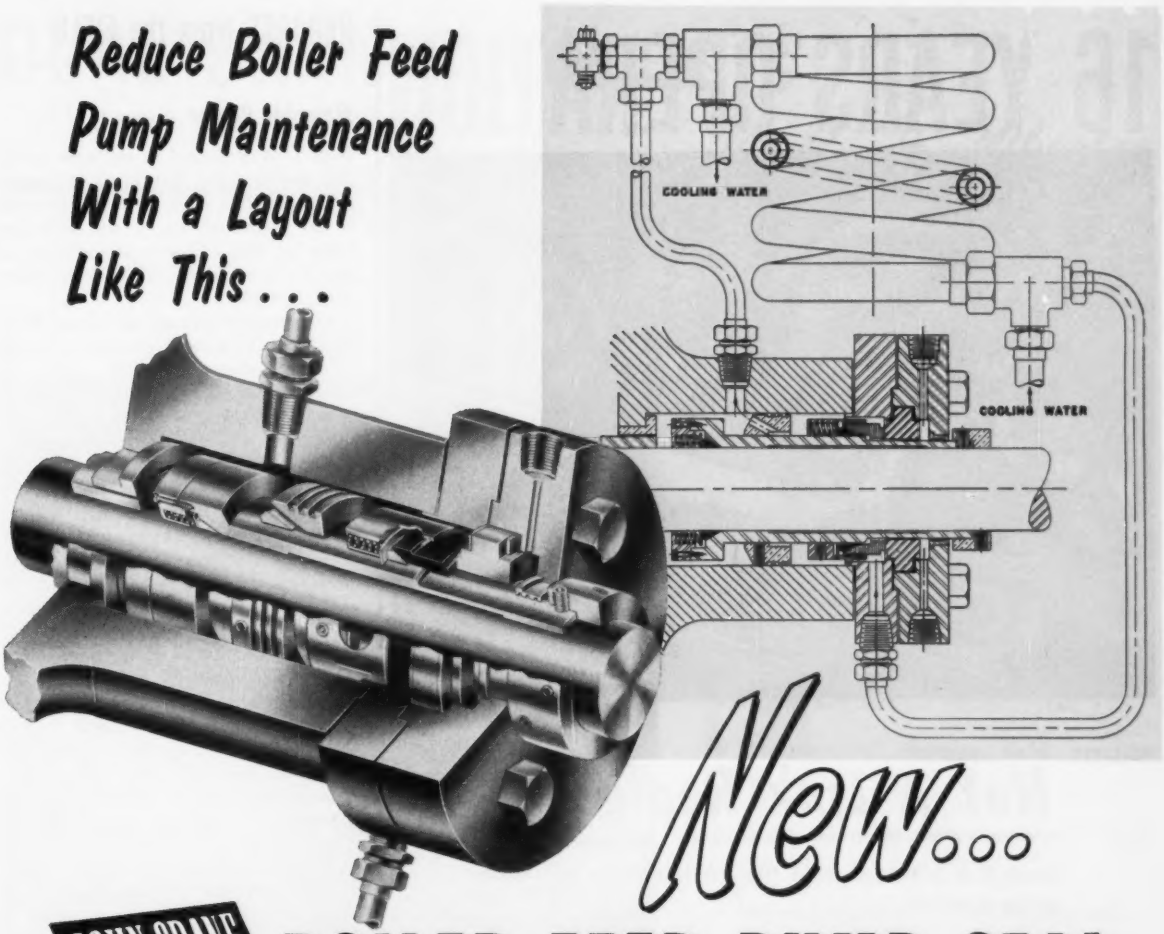
American Society of Mechanical Engineers. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, New York.

American Institute of Electrical Engineers. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, New York.

National Association of Corrosion Engineers, 12th Annual Conference. Identified by initials NACE. For further information contact NACE, 1061 M & M Building, Houston 2, Texas.

World Power Conference, 5th meeting, identified by initials WPC. Information as to availability obtainable from Oesterreichisches Nationalkomitee der Weltkraftkonferenz, Vienna I, Schwarzenbergplatz 1, Austria.

Reduce Boiler Feed Pump Maintenance With a Layout Like This . . .



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You get cost savings in four ways:

1. Replacement costs and "down time" are reduced. Service life is much longer than with other sealing methods.
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3. Long seal life—special closed circulating system provides cooling water in sealing chamber for best seal performance.
4. There is no leakage. Loss of valuable feed water is eliminated.

You get 4-way job-engineered performance:

1. "John Crane" engineers the seal to your operation. This includes adaption to your pump design and piping arrangement.
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4. "John Crane's" world-wide service organization and experienced engineering staff stand behind your installation.

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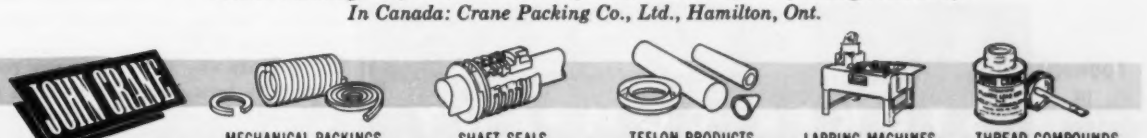

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Unretouched recent photo of 1940 Laclede Stoker installation at Pevely Dairy Co., St. Louis, Mo.

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REPORTS from the FIELD

Begins on page 156

Memphis Power continued

from TVA is about four mills per kwhr. But due to rising fuel, labor and materials costs, this TVA price will increase to an estimated 4.3 to 4.4 mills per kwhr by 1962. Cost to Memphis of its own electric energy will be at this same figure in 1962.

Cooperation between the city of Memphis and TVA will continue through an Interchange Agreement. After the Memphis contract for purchase of power from TVA expires in mid-1958, this agreement will enable an exchange of power so that whenever Memphis or TVA can supply it more cheaply, the other will have access to it.

Moreover, TVA has assured the municipality that it will take care of the Memphis area's power needs in the event of an interval between expiration of the present contract with TVA and adequate operation of the new Memphis power plant.

Plant site adjoins a new harbor and industrial development area. Three steam electric turbo-generator units will be built. Each of these will have a nameplate rating of 250,000 kw and a total net capability of 812,500 kw.

It is planned for the first of these units to be ready to go into operation in the latter part of 1958.

Sylvania and Corning form nuclear corporation

► PROPOSAL to form a jointly-owned company for expanded research, development and production activities in the atomic energy field, has been announced by officials of Sylvania Electric Products Inc and Corning Glass Works.

New organization, to be known as the Sylvania-Corning Nuclear Corp, will be incorporated in Delaware. Each company will own one-half of the new corporation's stock.

Sylvania's entire atomic energy business will become a part of the new company, and Corning will similarly transfer its atomic energy activities. Administrative headquarters and laboratories of the Sylvania division are located at the company's research center at Bayside, Long Island, with pilot production facilities at Hicksville, Long Island. Corning's activities are centered at Corning, N. Y.

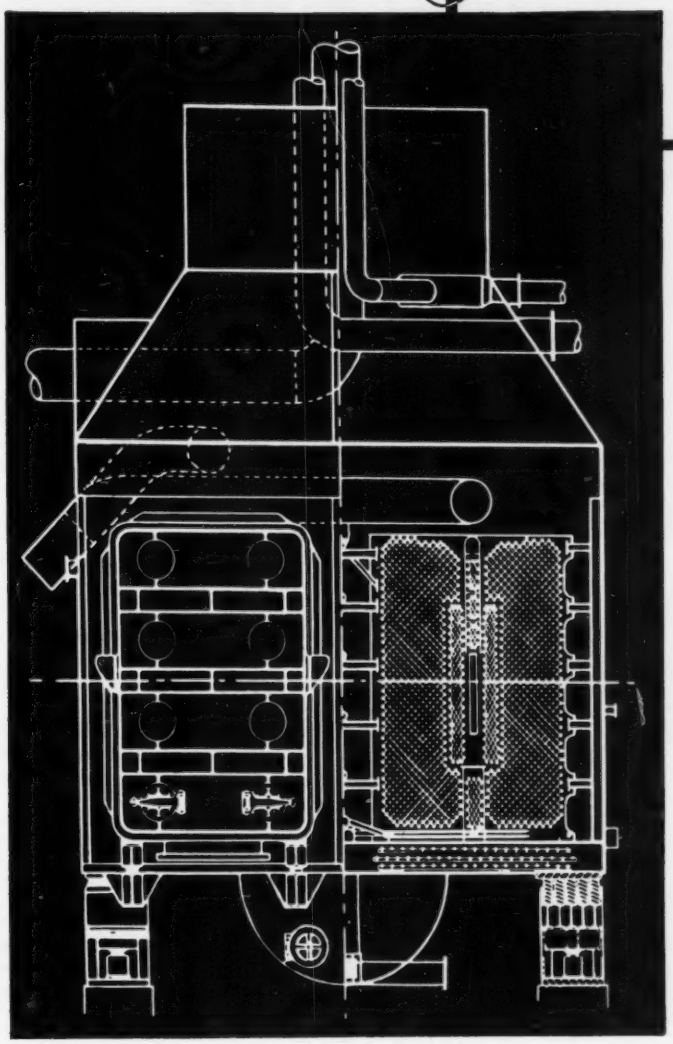
More than fifty sites for the new company have been investigated. Final selection will be made shortly from these.

Commenting on the potential of atomic power, the officials estimated that the nation's consumption of elec-

DUAL BANK Condensers

by C. H. Wheeler

For Your Electric Generating Plants of Tomorrow



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A ***severe acid,*** Blue Asbestos Teflon Packing. Each asbestos strand individually Teflon immunized. Special acid resisting lubricant. Highly compressible — no graphite.

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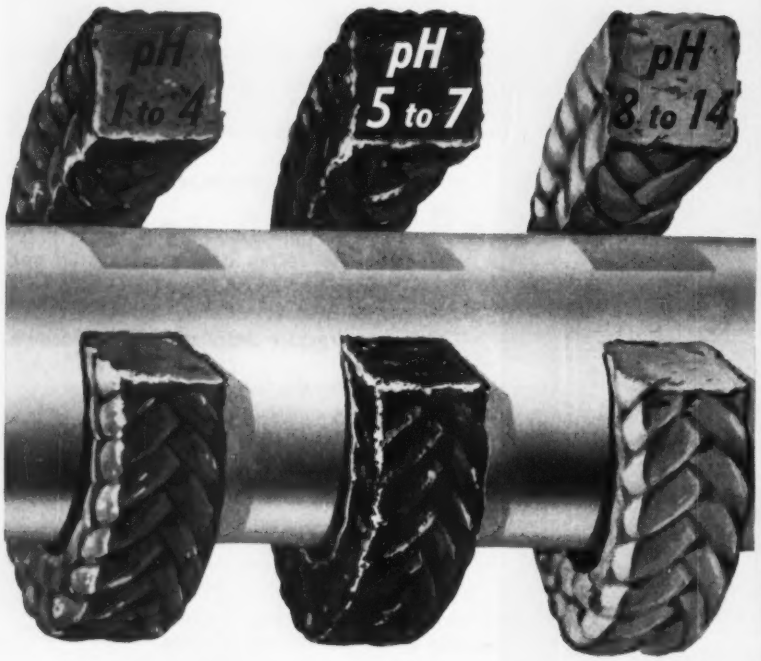
CHESTERTON WHITE-LON

A ***strong alkali,*** White Asbestos Teflon Packing. Highly compressible, caustic resisting lubrication. White in color. Each asbestos strand Teflon impregnated.



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REPORTS from the FIELD

Begins on page 156

tricity will more than double in the next decade, reaching 1 trillion kw by 1965. Although most of this power will be generated by conventional fuels an increasing proportion will be generated by nuclear-fueled power stations, they predicted.

Power show closes after big 4 days

► As the Power Show drew to a close, tired, happy engineers took a last tour of the exhibits, said goodby to old friends and started packing up for the trip home.

It had been a busman's holiday on a grand scale. In four days, the engineers kept up a pace designed to separate the men from the boys. Informal parties and sightseeing were sandwiched in between exhibition tours, formal dinners and ASME meetings.

This year's show was housed in Manhattan's newly-built Coliseum, something of a showstopper in its own right. Visitors paused between tours to speculate on the problems involved in building and operating the massive structure, and to comment on the blending of art and utility.

Of the displays, the most impressive were the models of atomic power stations scheduled to go into operation in the near future; the most spectacular—the guided missiles; the most significant—the exhibits of materials, structures and components put on by manufacturers of power plant equipment and production machinery.

At week's end weary exhibitors were congratulating themselves on one of the biggest and best power shows yet, and beginning to plan for "next time."

Calendar of Events

Jan 17-18—1957 Engineers Joint Council Assembly. New York Statler Hotel. Details from Engineers Joint Council, 29 W 39th St, New York 18, N. Y.

Jan 21-22—Association for Applied Solar Energy, 2-day symposium on solar furnace design and operation. Hotel Westward Ho, Phoenix. Details from AASE, 3424 N Central Ave, Phoenix, Arizona.

Jan 23-25—Twelfth Annual Symposium on Instrumentation for the Process Industries. Texas A & M College. Details from Dr C D Holland, Dept of Chemical Engineering, Texas A & M College, College Station, Texas.

Jan 28-31—Plant Maintenance and Engineering Show. Public Auditorium,

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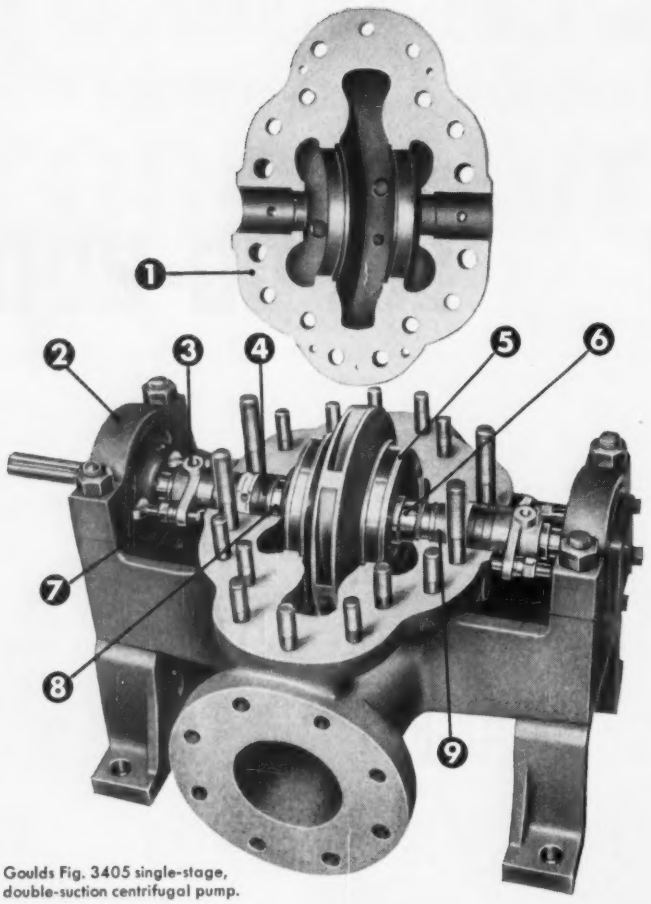

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You get all 9 custom features at standard pump prices

1. You can inspect, clean, and remove the entire rotating element without disturbing piping or pump and driver alignment.
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Only the Goulds Fig. 3405 offers all these cost-cutting features at no extra charge.

33 sizes pump 200 to 6400 GPM at heads up to 425 ft. Single-stage. Double-suction. Interchangeable parts—you can cut spares inventory by ½ or more.

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REPORTS from the FIELD

Begins on page 156

Cleveland. Details from Clapp and Poliak Inc, 341 Madison Ave, New York 17, N. Y.

Jan 30-31—3rd Annual Midwest Welding Conference. Illinois Tech Chemistry Bldg, 3255 S Dearborn St, Chicago. Details from Harry Schwartzbart, Supervisor of Welding Research, Armour Research Foundation, 10 W 35th St, Chicago 16, Ill.

Feb 25-March 1—American Society of Heating and Air Conditioning Engineers, 13th International Heating and Air Conditioning Exposition. International Amphitheatre, Chicago. Details from International Exposition Co, 480 Lexington Ave, New York 17, N. Y.

March 11-15—1957 Nuclear Congress, International Atomic Exposition. Convention Hall, Philadelphia. Details from exposition office, 304 Architect's Bldg, Philadelphia, Pa.

March 18-19—Steel Founder's Society of America, 55th Annual Meeting. Drake Hotel, Chicago, Ill. Details from SFSA, 606 Terminal Tower, Cleveland 13, Ohio.

March 25-27—American Society of Tool Engineers, Silver Anniversary Technical Meeting and Convention. Shamrock Hilton Hotel, Houston, Texas. Details from L S Fletcher, 10700 Puritan Ave, Detroit 38, Mich.

March 25-29—American Society for Metals, 10th Western Metal Congress and Exposition. Pan-Pacific Auditorium, Los Angeles, Calif. Details from ASM, 7303 Euclid Ave, Cleveland, Ohio.

Retired engineers respond to teaching proposal

► THE PROPOSAL that retired engineers be employed as teachers in New York City high schools has received "considerable response" from the engineers themselves, according to Mr Samuel Schenberg, Supervisor of Science, of the New York City Board of Education.

During a telephone interview with POWER's reporter, Mr Schenberg expressed the belief that the number of engineer volunteers warranted modification of existing teaching regulations.

He added that Superintendent of Schools William Jansen will review the applications and decide whether to request modification from the state commissioner.

The New York State Education Law requires a minimum of eight semester hours in professional education courses before licensing anyone to teach in the New York City secondary schools.

(*Continued on page* 236)

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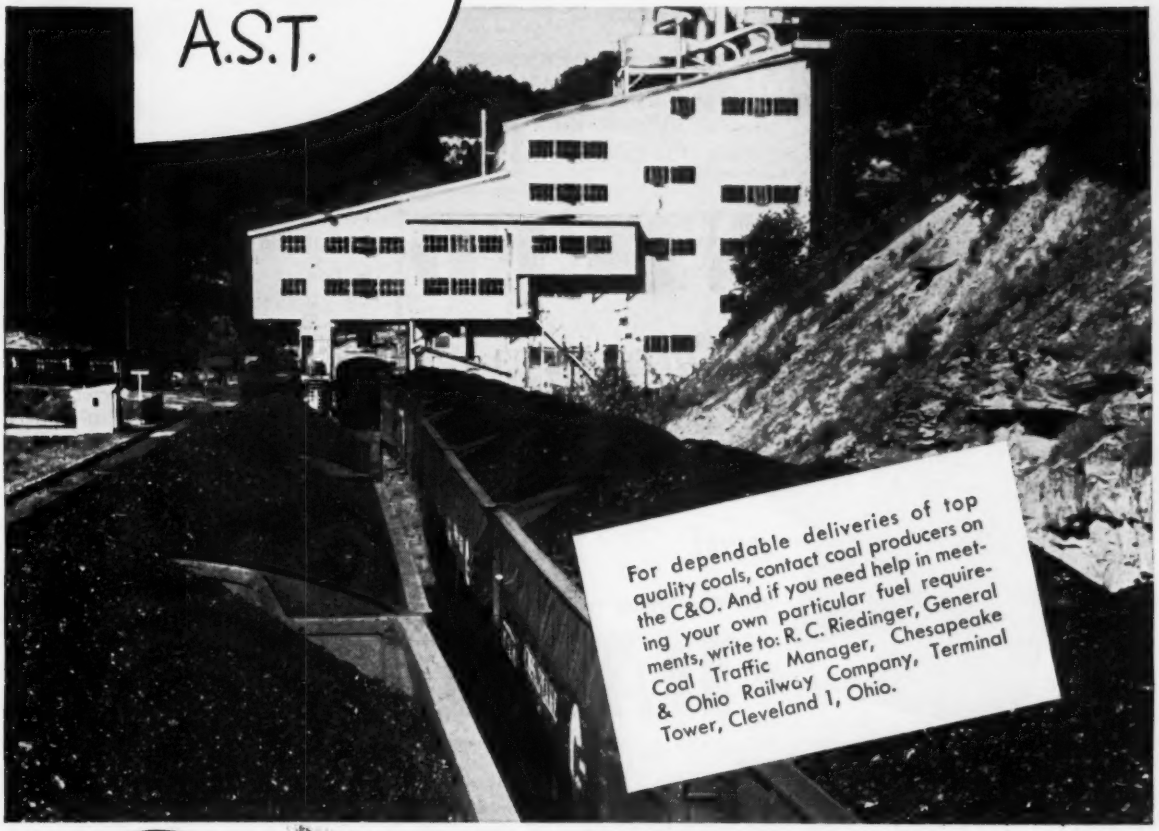
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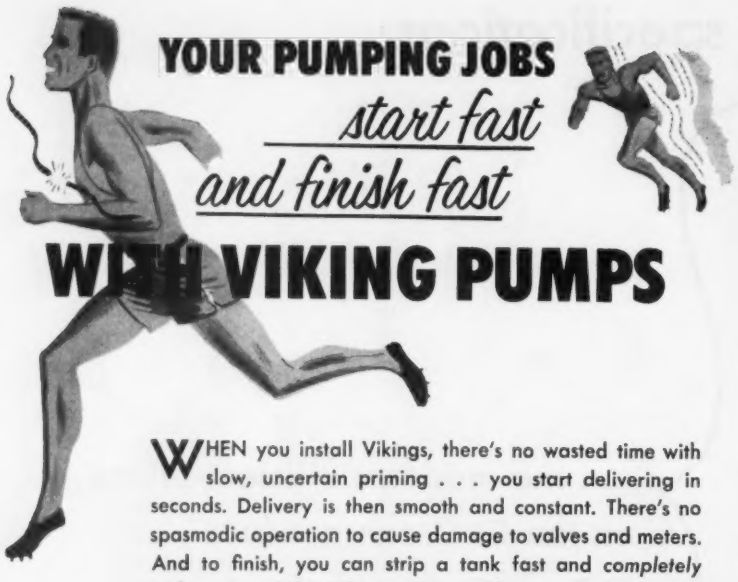

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REPORTS from the FIELD

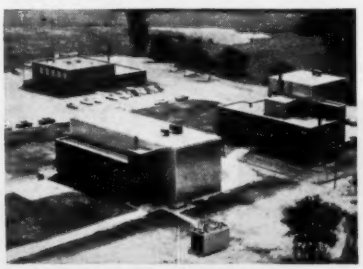
Begins on page 156

Such courses are not included as part of the degree requirements for scientists and engineers.

Dr Jansen has expressed a willingness to urge Dr James E Allen, New York State's Commission of Education, to consider modification if a sufficient number of engineers express interest.

Mr Schenberg said, at the time of the interview, that he had received 84 responses. Fifty of these were from retired engineers; 34 were received from active engineers interested in becoming teachers.

The possibility of employing retired scientists and engineers under the age of 70 was suggested last June 4 at a meeting of the Advisory Committee on Science Manpower.



Nuclear Research Center opens at Battelle Institute

► COMPLETION, at Battelle Institute, of the nation's first, privately owned Nuclear Research Center was announced following initial start-up of the Institute's one-million-watt research reactor.

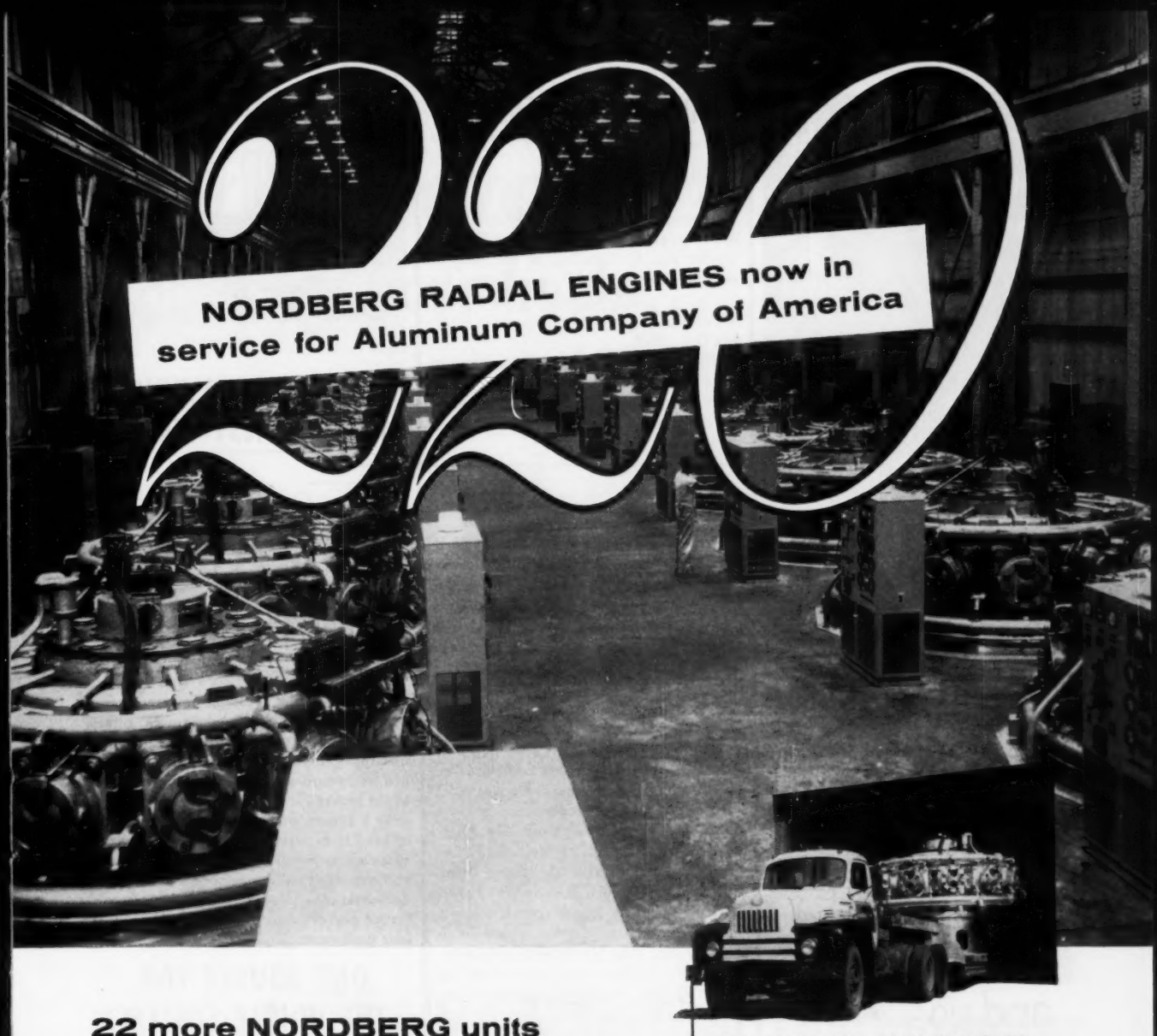
The ¾ million dollar reactor is the largest of the pool type yet to be put in service in this country. It is designed exclusively for research purposes. It becomes the third major new unit added to the Battelle Nuclear Research Center in the past 13 months.

Newly completed reactor uses solid U-235 fuel. The core, composed of fuel elements and boron control rods, is suspended 22 ft below surface in a large pool of highly purified water. Water serves as coolant and as a shield to protect personnel from radiations. It is expected that reactor will be operated 24 hours a day, six days a week.

Shown in photo above are research reactor (foreground), critical assembly laboratory (right), and hot cell laboratory (left background).

Snake River to get three 143,000-hp turbines

► THE U.S. ARMY has enlisted the aid of the S Morgan Smith Co, York, Pa., for a Corps of Engineers' project at



22 more NORDBERG units now on order will provide nearly 475,000 TOTAL HORSEPOWER

• The compact, lightweight Nordberg Radial engines are shipped as complete factory-assembled units. This 12-cylinder, 2125 hp gas burning engine, loaded on a flat bed trailer, is one of 26 units recently installed by ALCOA at their Point Comfort works.

A total of 220 Nordberg spark fired gas burning Radial engines with a capacity of over 400,000 horsepower have amassed a *startling total of over 8 million hours of dependable operation* at the Point Comfort, Texas smelting works of the Aluminum Company of America . . . by far the world's largest internal combustion engine power station.

As part of its continuing expansion of aluminum production facilities, ALCOA recently ordered 22 additional Nordberg units to provide power for a seventh pot line at Point Comfort. This new line will add 20,000 tons to the operation's installed capacity of 120,000 tons annually . . . requiring well over four million kwh per 24 hours.

The 22 newly ordered Nordberg engine-generator units will raise the power capacity to nearly 475,000 total horsepower, and will be the third expansion of electric power generating facilities for the electrolytic reduction of aluminum by Alcoa at Point Comfort.

These impressive repeat orders by ALCOA testify to the fact that the efficiency and low maintenance of the Nordberg Radial engines have contributed significantly to the lowering of aluminum production costs.

NORDBERG MFG. CO.
Milwaukee, Wisconsin

NORDBERG
DIESEL • DUAFUEL® AND SPARK-IGNITION GAS ENGINES

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P157

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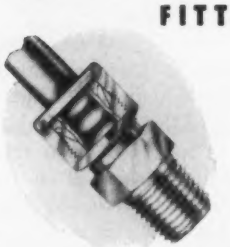
FITTINGS



GET ALL THE FACTS: Write for the Swagelok catalog. Address Dept. E-2

CRAWFORD FITTING CO.

884 EAST 140th STREET

CLEVELAND 10, OHIO

REPORTS from the FIELD

Begins on page 156

Ice Harbor Lock and Dam on Snake River.

Three 280-in. Smith Kaplan turbines, most powerful of their kind in the world, will be installed at the project site 12 miles from Pasco, Wash. Installation will be completed July 1960, with shipment of embedded parts starting Dec, 1958.

The turbines will operate over a head range of 78 to 102.5 ft. Their rating is 143,000 hp at 90 rpm under an 89 ft head.

POWER'S History

POWER was founded in 1884 by E P Harris and H M Swetland. With it was incorporated *Steam* which had been started by N Hawkins in Chicago two years earlier.

In 1903 POWER purchased and absorbed *Science and Industry*, which was a consolidation of a number of periodicals, namely, *Home Study Magazine, Home Study for Machinists, Mechanic's Magazine, Home Study for Building Trades, Building Trade's Magazine, Home Study for Electrical Workers* and *Steam Electric Magazine.*

In 1908 POWER absorbed *The Engineer's Review*, of Cleveland, and *The Engineer*, of Chicago, the latter being a consolidation of *The Safety Valve, Lord's Power and Machinery Magazine, The Stationary Engineer, Steam Engineering* and *The Mechanical Engineer.* When *The Engineer* was purchased, the name of the combined magazine was *Power and the Engineer.* The title was condensed to POWER in 1911. In 1951, POWER absorbed *Operating Engineer.* All rights to above titles reserved.

A.G.E. chooses site for second 450,000-kw power unit

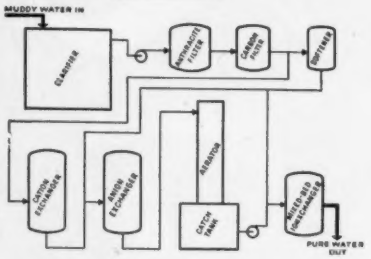
► PHILIP SPORN PLANT, in the heart of the Ohio River Valley, has been chosen as the site for the second of two 450,000-kw electric power generating units, according to officials of American Gas and Electric Service Corp.

Sporn Plant is on the A.G.E. System at Graham Station, W. Va, and at present has a generating capacity of 600,000 kw. It is jointly owned and operated by Appalachian Electric Power Co and Ohio Power Co, A.G.E. operating subsidiaries.

Like its A.G.E. System sister unit, which is being built by Indiana & Michigan Electric Co in Sullivan County,

ILLCO-WAY ionXchange

HIGH-PRESSURE BOILERS NEED PUREST WATER



An ILLCO-WAY System, incorporating up-to-date ionXchange equipment, offers the best opportunity available today for obtaining the high-purity water that modern high-pressure boilers *must* have to avoid serious loss of operating efficiency. Such a System will take the muddiest kind of hard river water and clean it up so that suspended impurities, mineral content, and dissolved solids are reduced to almost unmeasurable quantities. The result — top boiler performance, always, and top *turbine* performance.

ONE SOURCE FOR THE WHOLE SYSTEM

Today, such a System can be obtained, *complete,* from a single source — Illinois Water Treatment Company. We design and manufacture every element to solve successfully the particular application. You do not need to combine a part from here and a portion from there — you get it *all* from us, all tanks, all piping, all valves and controls, all resins and other materials, all carefully selected to suit *your* needs. *Consult our experienced engineers at the next opportunity . . .*

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CANADIAN DIST: PUMPS & SOFTENERS, LTD. LONDON, ONT.

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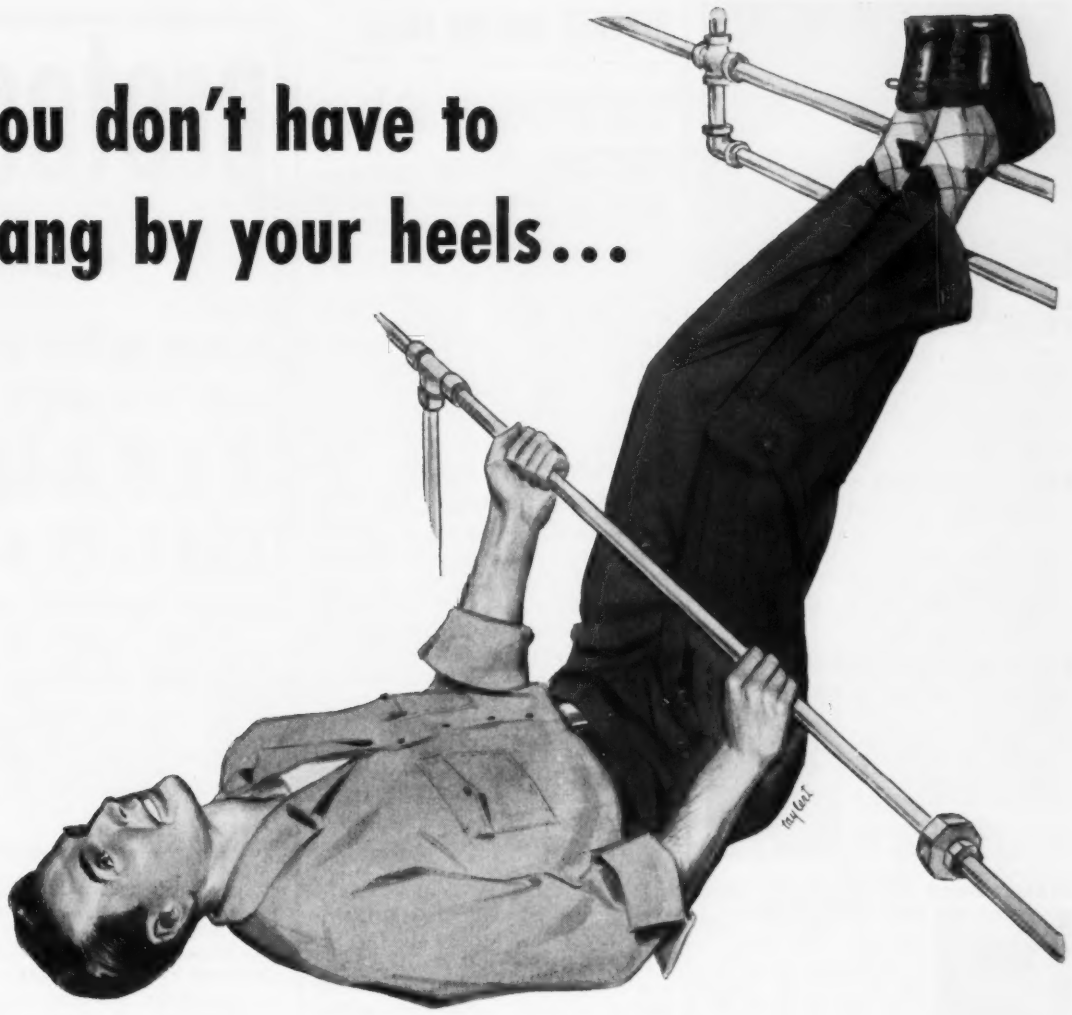
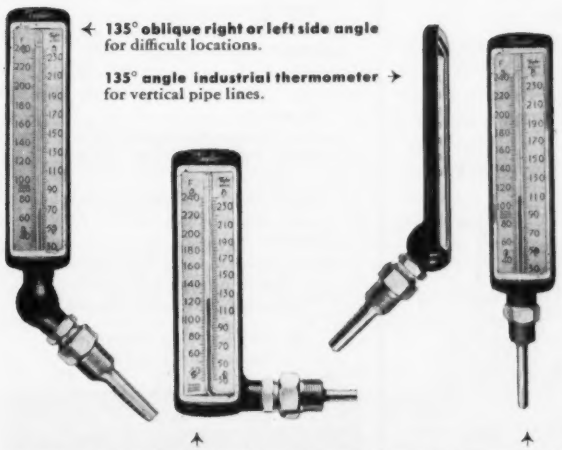


to read a Taylor Industrial Thermometer



← **135° oblique right or left side angle** for difficult locations.

135° angle industrial thermometer → for vertical pipe lines.

90° right or left side angle for side installations. Can be tipped forward or backward for eye level reading.

Straight industrial thermometer for inserting in horizontal pipe lines.

EASY-READING Taylor Industrial Thermometers come in a wide variety of stem angles and connections to fit the most difficult applications.

Easy temperature readings mean *more frequent* temperature readings—greater protection for your expensive equipment and more efficient plant operation.

Exclusive BINOC* tubing and extra-bold black numerals make Taylor Industrial Thermometers *three-times-easier-to-read.* Ranges from minus 40° to plus 950°F. or equivalent Centigrade. Built for years of rugged, reliable service. Write for **Catalog E.** Taylor Instrument Companies, Rochester, N.Y., and Toronto, Canada.

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Taylor Instruments
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To see what's going on inside

When you want to look into a furnace, watch acid eat its way into metal, observe a white hot melt in cool comfort, there's only one answer . . . GLASS.

PYREX brand PLATE GLASS No. 7740 is particularly suited for odd-sized sight glasses, fume duct windows, and chemical-resistant surfacing. You can use it for temperatures up to 900° F. It is resistant to thermal shock and indifferent to chemical attack.

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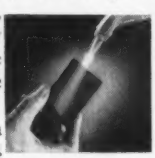
PYREX brand INFRARED-REFLECTING GLASS reflects radiation in the infrared spectrum but transmits up to 75% of visible light. Useful as an efficient shield to protect workmen from exposure to intense heat radiation.

CORNING HEAT-RESISTANT BLUE OBSERVATION GLASS, reduces glare when observing flame, smoke and ash intensity in power plants, marine boiler stations and the like.



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REPORTS from the FIELD

Begins on page 156

Ind., the new Sporn unit will be 73% larger than any other power-producing unit operating today.

In commenting on selection of the Sporn Plant for location of the second unit, Philip Sporn, A.G.E. president, said, "Our decision was based on three important factors: the need for still greater generating facilities in the dynamic Ohio Valley, the fact that the plant is situated near the geographical and load centers of the A.G.E. system, and the plant's proximity to abundant low-cost coal reserves."

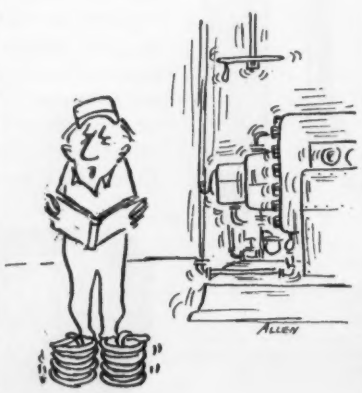
Dr Zinn heads new company in atomic energy field

► THE FORMATION of a new company in the atomic energy field, the General Nuclear Engineering Corp, was announced today by its president, Dr Walter H Zinn, former director of the Argonne National Laboratory.

The company has been formed for the purpose of providing engineering and other services in connection with the design, construction and operation of nuclear reactors and other atomic energy facilities. The company also plans to carry out research and development work in connection with such activities.

The key technical associates of Dr Zinn in the new enterprise are Mr Harold V Lichtenberger, Mr John M West, and Dr Joseph R Dietrich. These men bring to the company a combined total of 54 years in the atomic energy field.

The company, located in the St. Petersburg-Tampa area of Florida, plans to offer its services to foreign countries and to organizations planning a research reactor and a program for its use. The address is P.O. Box 245, Dunedin, Florida.



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Retard wear, quiet gears. Waterproof. Will not drip when gears are idle or in motion.

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Quick-acting. Cut rust as well as lubricate. Loosen sticky valves, eliminate squeaks.

Order Albany Lubricants through your supply house.

Serving industry throughout the world since 1868.

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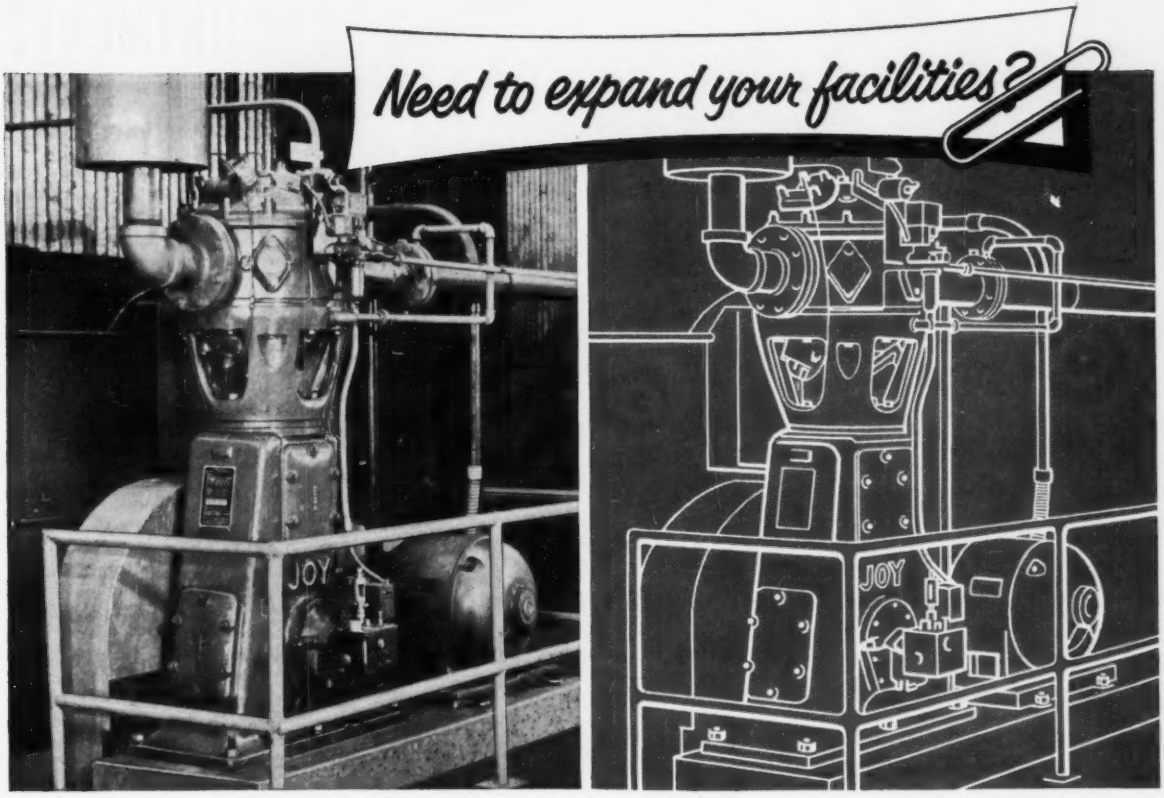

Add compressed air power efficiently with the JOY WG-9

The Joy WG-9 *heavy-duty* vertical air compressor is a natural for supplying additional air for an existing system, either centralized or decentralized.

Because of its smooth running characteristics and the small floor area required, the WG-9 needs only a simple, block-type foundation. The average base dimensions of a larger model WG-9, *including motor,* are 7′1″ by 4′1″. This means greater capacity per square foot of floor area—42 CFM per square foot on the 100 psi rated machines.

Thus, the WG-9 packs large compressor capacity in a small compressor area. It is possible to install the machine in a central compressor room where unused floor space is at a premium, or in a decentralized plant location where crowding of machinery is a problem.

If you have plans for a small plant, the WG-9 is designed to give you continuous 24-hour heavy-duty service. It is also widely used to meet special requirements in larger operations, such as boosting air above standard plant pressures.

The Joy WG-9 is a water-cooled compressor, available in capacity ranges up to 881 CFM piston displacement and in pressures up to 150 psi. Standard drive is multiple V-belt. This machine can be furnished for flat belt or vee flat drive if desired.

LARGE COMPRESSOR FEATURES INCORPORATED IN ALL WG-9 SERIES

- Full Force Feed Lubrication
- Joy Patented "Dual-Cushion" Valves
- Anti-friction Main Bearings
- Replaceable Cylinder Liners and Crosshead Guides

Write today for full information. ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Write for FREE Bulletin 22-16

Consult a Joy Engineer

For Air and Gas Compressors, Oxygen and Nitrogen Generators, Vacuum Pumps and Boosters, Conveyors, Fans, Electrical Connectors, Hydraulic Fittings and Hose Assemblies.

W&O I 5854-22

JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885

if

you have any of these troubles:

1. **SCALE, CORROSION, or FOAMING** *in your boiler operation.*
2. **RUST and CORROSION** *in your steam and condensate lines.*
3. * **SCALE, CORROSION, or ALGAE GROWTH** *in your cooling or condenser water system.*
4. **CORROSION or SCALE** *in your hot or cold water tank and lines.*
5. **RUST and CORROSION** *in your brine or sweet water system.*
6. **SCALE** *in pumps, water jackets, compressors, coils, lines, or equipment.*
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then . . . let WESTERN prove to you how a specific treatment applied to your specific problem can restore and maintain efficiency and economy in your use of water, steam and fuel. Check the number or numbers of the problems you have in the coupon below. Get full information.

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APPOINTMENTS

Corporation executive changes

Riley Stoker Corporation: Robert K Griffith, vice-president and treasurer of Riley Stoker Corporation; director, vice-president and assistant secretary of Badenhausen Corporation: director and assistant secretary of A W Cash Company and director of Cash Standard Stacon Corp. **Copeland Refrigeration Corporation:** Frank J Gleason, president. **Milwaukee Valve Company:** Carl E Rowe, vice-president and general manager.

Prat-Daniel Corporation: Conrad H Pinches, president. **Sperry Western, Inc:** Robert B Manning, president. **General Precision Laboratory Inc:** Raymond L Garman, executive vice-president and technical director; James W Murray, executive vice-president and general manager; Richard W Lee and William J Tull, vice-presidents.

LaSalle Steel Company: T Lloyd Kelly, chairman of the board; Thomas A Kelly, president and chief operating officer. **Hercules Motors Corporation:** Walter L Brough, executive vice-president. **Infilco, Inc:** E G Kominek and A A Kalinske, vice-presidents. **New York Air Brake Company:** Thomas W Johnson, vice-president. **Southern California Edison Company:** James F Davenport, executive vice-president. **The Cleveland Worm & Gear Company:** Sidney L Eastman, vice-president, engineering. **Aluminum Company of America:** James P Haight, vice-president, engineering.

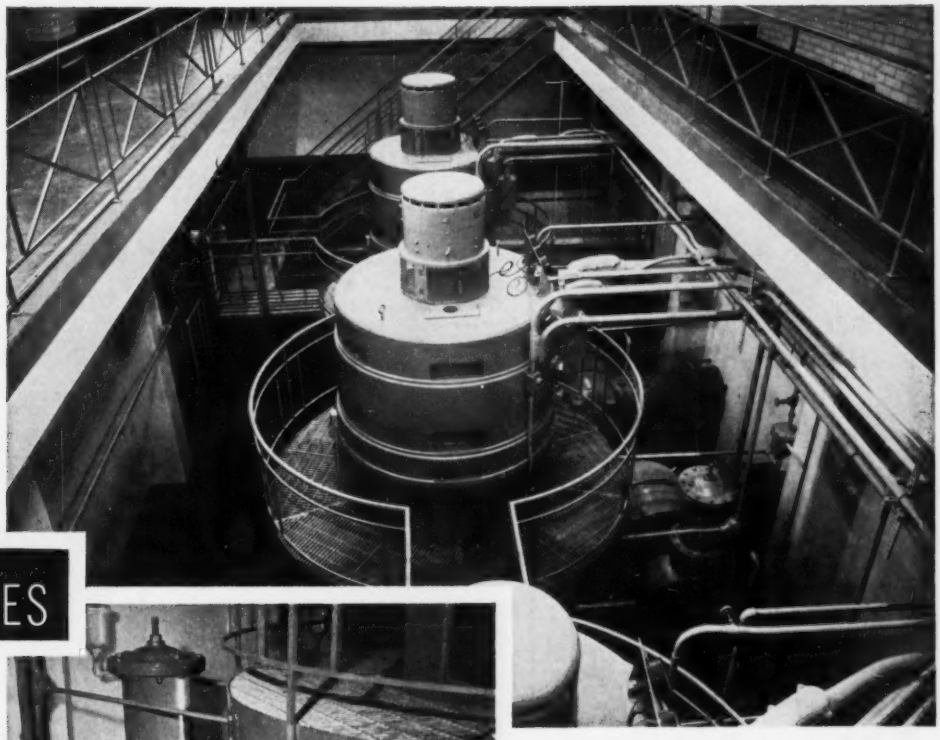
Engineer changes

Aluminum Company of Canada, Ltd: Franklin T Matthias, chief engineer. **Fairbanks, Morse & Co:** R H Beadle, chief engineer, diesel engineering dept. **Nordberg Manufacturing Company:** Albert T Metcalf, electrical engineer. **Bryant Manufacturing Company:** William M Day, director of engineering. **Argonne National Laboratory:** Jay R Ginder, assistant mechanical engineer, reactor engineering division.

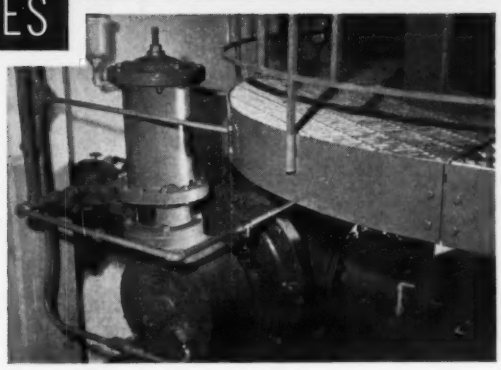
Sorenson & Co: Jesse Stitzer, chief engineer of Beta Electric division. **American Can Company:** Harold Palmer, general manager, engineering. **Great Northern Oil Company:** Lloyd E Lundahl, chief engineer and assistant maintenance superintendent. **Allis-Chalmers Manufacturing Company:** L T Rosenberg, chief generator design engineer; G W Staats, engineer-in-charge, generator design section.

New district managers

United States Rubber Co: Louin L Jewel, Buffalo district. **Joy Manufacturing Co:** John E Moody, Boston



SMS
ROTOVALVES



Ten hydraulically operated SMS-Rotovalves here range in size from 18″ to 30″.

Engineers: Greeley & Hansen, Chicago.

For the City of Niagara Falls, N.Y. . . .

SMS-ROTOVALVES SAFEGUARD HIGH AND LOW SERVICE PUMPS

SMS-Rotovalves were specified to safeguard service pumps in the City of Niagara Falls' new pumping station. Greater initial shut-off and positive control of closing time made them a logical choice to minimize water hammer in pump start-ups and shutdowns. Because SMS-Rotovalves have less pressure loss with a full line opening than other valve types, they save pumping power.

In addition to the SMS-Rotovalves, SMS Babbit-Seated Butterfly Valves meet the rugged, high service header requirements of fast, positive closure. At the adjacent filtration plant, 76 R-S Rubber-Seated Butterfly Valves were specified to give drop-tite closure, unusual economy of layout space and cut initial construction costs.

Whatever your application requirements, SMS has the experience and facilities to meet them. For additional information on our complete line of cone, ball and butterfly valve, see our local representative or write the S. Morgan Smith Company, York, Pennsylvania.

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Gates & Hoists
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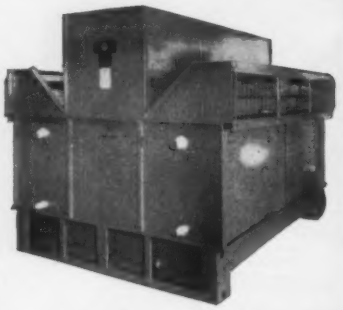
Accessories

HYDRODYNAMICS

Rotovalves
Ball Valves
Butterfly Valves
Free-Discharge Valves
Controllable-Pitch Ship Propellers

S. MORGAN SMITH CO.

AFFILIATE COMPANY: S. MORGAN SMITH, CANADA, LIMITED, TORONTO



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- **Because the new design improves the heat transfer to the out-door air by evaporation.**
- **Because new features keep your equipment working for long life with "new plant" efficiency . . . always full capacity.**
- **Because you save 95% of cooling water cost.**

You get faster, more accurate cooling of industrial fluids to specified temperatures.

You improve your quality of production by removing heat at the rate of input.

You save labor in upkeep. With full access to all interior parts and piping you see everything in easy inspections. You head off dirt accumulation and corrosion. Casing panels are removable without moving the coils. The coils can be cleaned from both sides.

First cost is low; freight is low because of the lowest space/weight ratio; you save much labor in erection. Capacity range is 7,000,000 to 18,000,000 Btu/hr. No other heat exchange method gives you so much saving in money and convenience.

Write for Niagara Bulletin No. 132

NIAGARA BLOWER COMPANY
Dept. P, 405 Lexington Ave.
NEW YORK 17, N. Y.
District Engineers in Principal Cities of U. S. and Canada

More APPOINTMENTS

Begins on page 242

office. **American Chain & Cable Company:** R A Willson, New York and New England territories for Wright Hoist division. **The Kennedy Valve Mfg Co:** Jack W Skinner, West Coast branch.

Link-Belt Company: George A Most Jr, Boston district; J Charles Bullock, Moline, Ill. district; Gene A Zwerner, Albany, N. Y. district; C C Wiley, Washington, D.C. district. **Sylvania Electric Products Inc:** Carl S Long Jr, lighting sales manager of Rocky Mountain district. **Clark Bros Co:** William T Durkin, Pittsburgh office. **The Swartwout Company:** R L Broderick, Houston district for Autronic Process Controls division. **Weston Electrical Instrument Corporation:** Kenneth C Moulton, Los Angeles office; Edward B Annett Jr: Cincinnati territory; Dudley K Bailey, Buffalo territory.

New sales engineers

Manning, Maxwell & Moore Inc: Roger Gilliland, Los Angeles office. **Thermal Research and Engineering Corp:** William Page, Cleveland office; Harold Horn, New York office. **C & D Batteries Inc:** Clayton J Roderick, Jackson, Miss. area. **Research-Cottrell, Inc:** John G McDonnell, Pittsburgh office. **Johnson Service Company:** James W Taylor, Memphis branch. **Food Machinery and Chemical Corporation,** Peerless Pump division: Max H Richter Jr, New Orleans and George Ries, Cleveland.

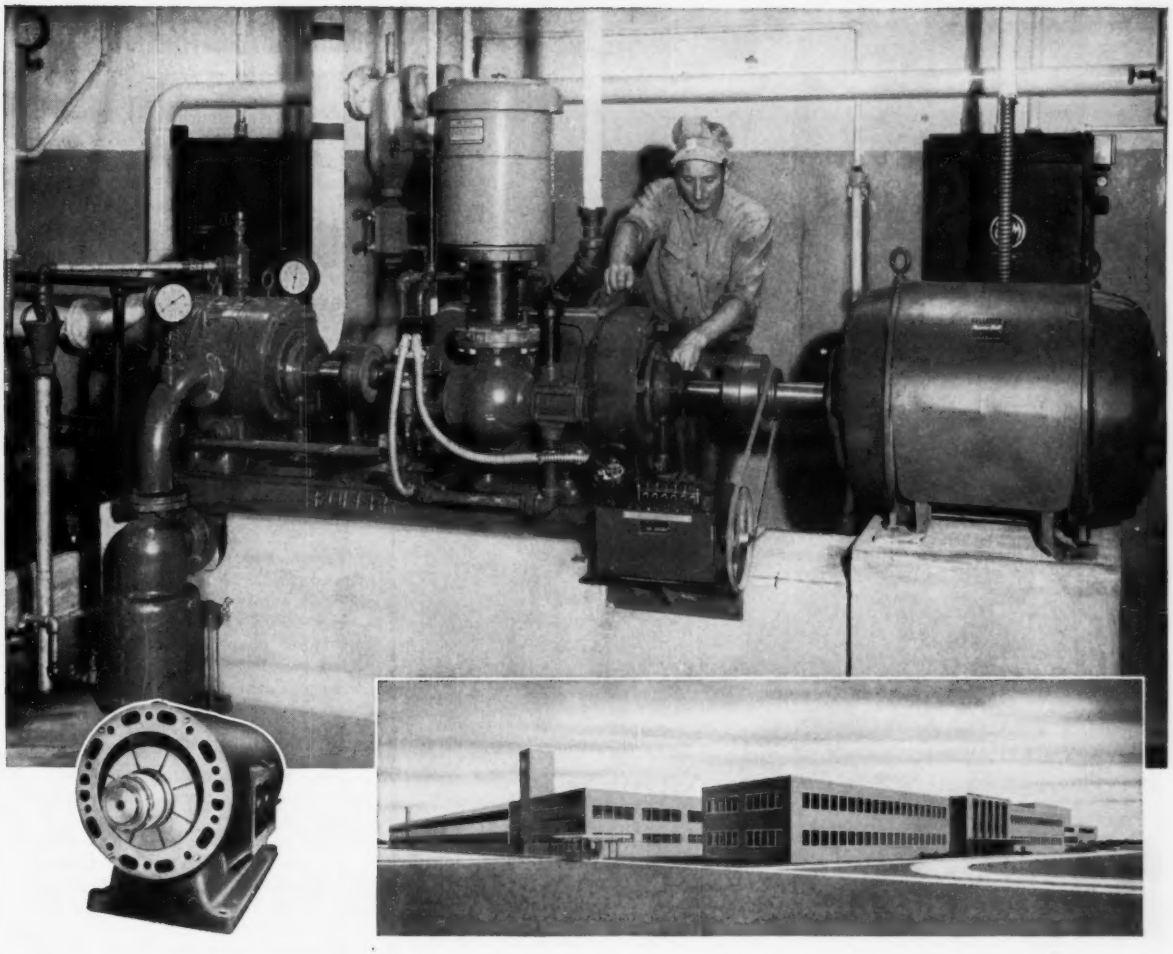
New representatives

For **A W Cash Co:** E C Cooley Co, 1186 Folsom St, San Francisco 3, Calif.; Gay Sales Company Associates, 420 Sul Ross St, Box 13232, Houston, Texas; Lytle Engineering Specialties Ltd, 360 Notre Dame St, W, Montreal 1, Quebec, Canada; McGinnis-Hill Co, 4809 Clinton Hwy, Knoxville, Tenn.; Noel Moffitt Co, Ltd, 203 Church St, Toronto, Ontario, Canada; North-Monsen Co, Box 174, Salt Lake City 10, Utah; Richard S Dawson Co, 333 Glendale Blvd, Los Angeles 26, Calif.

For **Orr & Sembower, Inc:** C R Hutcheon, Inc, Livingston, N. J.; Harry Hoyle Contracting Co, Nyack, N. Y.; Allen Bullard Company, Little Rock, Ark. For **Walsh Refractories Corporation:** Kenneth M Stuerman, greater St. Louis area, southern Illinois and Missouri; S McCord, Quad City area. For **Conoflow Corporation:** Lewis M Crowe Company, Station C, Box 7387, Atlanta 9, Ga. For **Tuthill Pump Company:** Atlas Equipment Company, 620 Meynard Ave, Seattle 4, Wash.

For **Hammel-Dahl Company:** The Belilove Company-Engineers, 420 Mar-

Yes...
McDONNELL CONTROLS FOR BOILERS TO 250 psi.
No. 192 Illustrated
McDONNELL 92 SERIES
Pump Control, Cut-Off and Alarm Switch
Underwriters Listed
Here's a whole new concept of control design and performance . . . with the best-known name in its field. Introduces repulsion magnetic switching, for positive opening and closing. Beats the heat as never before—okayed for 75° C. (167° F.) wiring. Has extra generous float clearances; operating levels that are not affected by pressure changes; and a host of other refinements.
Write for Bulletin L-123
Shows 92 Series models with or without integral water column. Has full engineering data for controlling pumps or electric valves on boiler or tanks, for low water cutoff and alarm, etc.
Also shows companion 91 Series, for pressures to 150 psi.
McDONNELL & MILLER, INC.
3506 N. Spaulding Ave., Chicago 18, Ill.
McDONNELL
Boiler Water Level Control



Modern, reliable air power for a modern, efficient plant

When Electric Controller & Manufacturing Company, Division of Square D Company, Cleveland, Ohio, designed and built its new four and one half million dollar plant, they had their sights set on economical production at high-level efficiency.

One of the items given serious consideration was the supply of compressed air, a considerable quantity of which is used throughout the plant. Fuller Company is justifiably proud to be associated with such a plant in being awarded the contract to furnish a Fullery Rotary Two-stage compressor as the main source of general plant air . . . a modern, efficient compressor for a modern, efficient plant. This machine has a capacity of 281 c.f.m., at 100-lb pressure.

Fuller Rotaries do a very big job no matter how tough the going. It's a job that, more and more, is being multiplied throughout all industry, these machines having gained wide acceptance as an efficient, reliable source of air power.

The key to Fuller's long life, and smoother operation, is *rotary motion*, which provides large capacity in relation to size, simple direct drive from motor or internal-combustion engine, minimum of working parts, air-flow free from pulsations, lack of vibration, continuous service with minimum supervision and maintenance. Installation in cramped quarters or on ordinary flooring is simple and practicable.

For a full description of Fuller Rotary Compressors and Vacuum Pumps, we would like to send you a copy of Bulletin C-5A. Write for your copy today.

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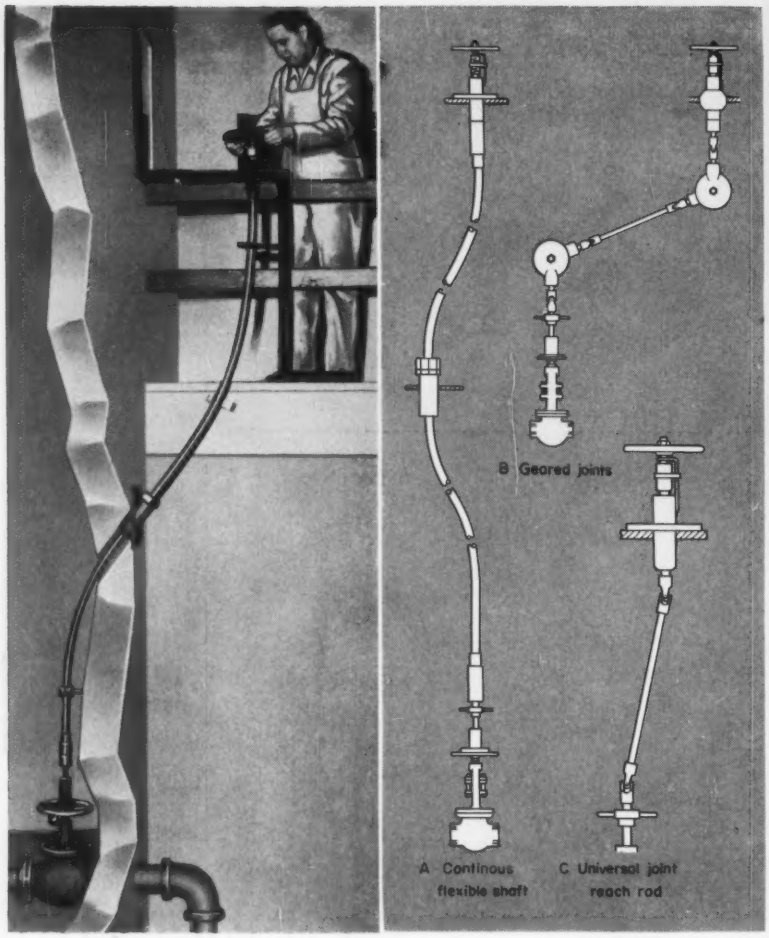
PIONEERS OF HIGH-EFFICIENCY VANE TYPE ROTARY COMPRESSORS SINCE 1930



Typical station arrangements

Remote control for valves

In recent years increasing numbers of manual remote controls have been installed in industrial power plants and on nuclear reactors. These systems are popular because they eliminate a great deal of hazardous climbing and permit relatively inexpensive control of a number of widely scattered valves.

Stow Manufacturing Co. makes a complete line of these controls, including: flexible shafting, universal joints and geared joints. These controls also include standard remote stations, intermediate connections and valve couplings for both flexible shafting and reach rods.

Typical installations of this equipment are shown above. Sketch "A" shows a flexible shaft that can be used up to 100 ft. in length and is available in sizes up to 1⅝" diameter. Sketch "B" is an installation using geared joints that operate in any angle through 340°.

For complete design data on all sizes of standard flexible shafts, geared joints and terminals, write for Design Manual 553.

STOW MANUFACTURING CO.
181 Shear Street, Binghamton, N. Y.

More APPOINTMENTS

Begins on page 242

ket St, San Francisco 11, Calif. For **Lunkenheimer Co:** W B Garrison, Rocky Mountain territory with headquarters in Denver; Jack L Green, Houston, Texas territory. For **Hills-McCanna Company:** R S Stover Company, Kresge Bldg, Marshalltown, Iowa.

Institute elections

American Society of Mechanical Engineers: William F Ryan, president. **Conveyor Equipment Manufacturers Association:** J H Walker, president; Adrian W Rich, vice-president; H E Murken, treasurer; J B Nordholt Jr, secretary; L J Johnson, R Y MacIntyre, Frank J Shude, directors; R C Sollenberger, executive vice-president. **Engineers Joint Council:** Joseph Warren Barker, president; Fischer S Black, vice-president. **Diesel Engine Manufacturers Association:** Walter A Rentschler, president. **New Jersey Utilities Association:** Watson F Tait Jr, president; Charles E Kohlhepp, vice-president.

Retirements

John R McConnell, vice-president of American Air Filter Co, Inc, after 33 years in the air filter business.

Grant E Cole, executive vice-president and general manager of Trane Company of Canada, Ltd, after 32 years of service to the company.

A C Embshoff, manager of industrial division of Infilco Inc. He will continue with the company as a general consultant to the sales division.

Everett S Lee, editor of the General Electric *Review,* after more than 40 years of service with the General Electric Company.

Obituaries

Lance L Simmons, 57, executive engineer of American Blower Corporation; past president of the Heating and Cooling Coil Manufacturers' Association; on November 8th.

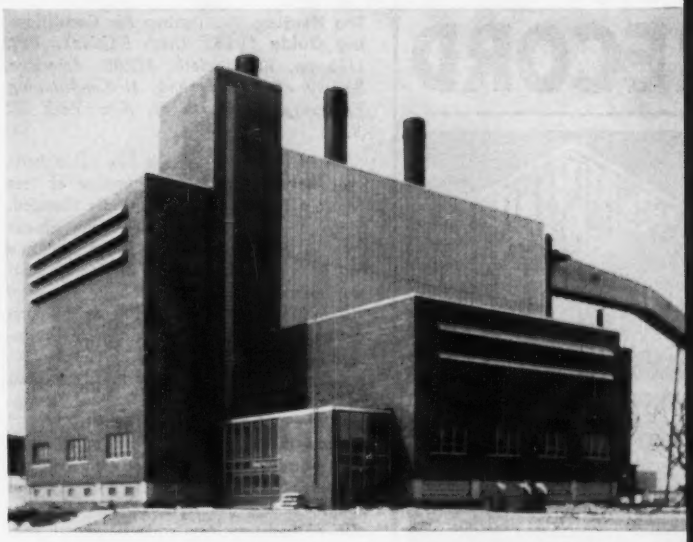
Frank H Thorne, vice-chairman of National Aluminate Corporation, on October 26th.

George A Brooke Jr, 70, founder and retired president of Brooke Engineering Co, Inc.

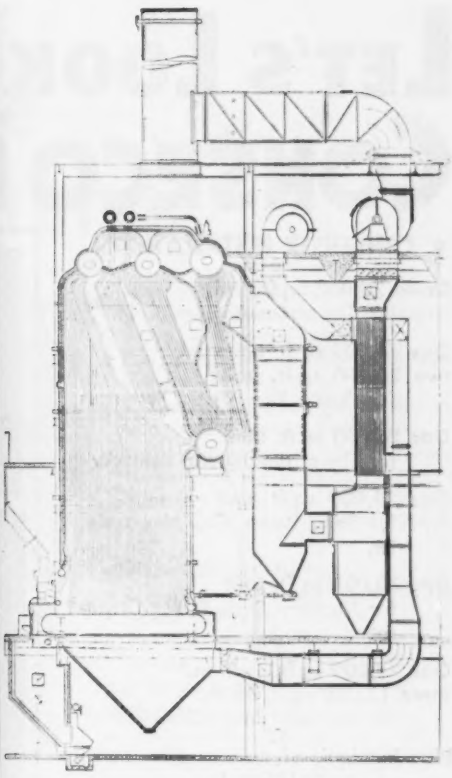
Joseph F Ryan, 61, assistant secretary and assistant treasurer of Allis-Chalmers Manufacturing Company, on October 23rd.

Moro M Borden, 79, engineering consultant of the Simplex Valve and Meter Company, on November 16th.

Babcock and Wilcox Co is the first firm in the U.S. to obtain general license from AEC to receive and use special nuclear and nuclear source materials.



Power Plant, Milwaukee County Institutions



Longitudinal Section of Union Type B Boiler

Union Boiler Trio scores 86.52% in efficiency test at Milwaukee County Institutions

Grouped on a 1200-acre tract, Milwaukee County Institutions have the self-sufficiency of a small community. With 4 hospitals, a sanitarium, children's home, administration building and nurses' home, this health and child-care center has its own fire department, bakery, laundry, garage and power plant. In all, there are 35,000,000 cu. ft. of buildings providing complete facilities for 6000 patients and 3100 employees.

Three Union 4-drum, Type B Boilers handle the entire steam demand for space heat and electrical power. Each has a continuous capacity of 110,000 lbs./hr. at 625 psig and 745° F. *The institutions have no other source of heat or power!*

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BOOKSHELF

The Heating Ventilating Air Conditioning Guide 1956. *(34th Edition). 6x9, 1176 pp, illust, cloth. $12.00. American Society of Heating and Air-Conditioning Engineers, 62 Worth St, New York 13, N.Y.*

As in previous years, it has again been necessary to increase the number of text pages. Chapters are substantially changed. Some are new, others have been almost completely rewritten. Particular attention has been given to the presentation of heat-transmission coefficients of building materials. More tables make it easy to compute the effect of adding air spaces or insulations to walls, ceilings or floors.

Other material which has been rewritten concerns automatic control and a description of current-control equipment.

This edition contains a total of 53 chapters grouped under seven sections—fundamentals, human reactions, heating and cooling loads, combustion and consumption of fuels, systems and equipment, special systems, and instrument and codes.

The Mechanical Properties of Wrought Phosphor Bronze Alloys. *ASTM Technical Publication No. 183. 6x9, 120 pp, paper. $3.00. American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa.*

This volume shows the effect of cold-working on the mechanical properties of a series of eight phosphor bronze alloys in two conditions in the form of cold-rolled strip with varying tin content from 0.5 to 10%. Electrolytic tough-pitch copper-strip similarly treated is included to provide a base for evaluating the effectiveness of the tin additions.

The mechanical properties — including tensile strength, proportional limit, yield strength at both 0.01 to 0.2% offset, modulus of elasticity, elongation, bending fatigue characteristics, lifetimes ranging from 100,000 to 1000 million cycles and the Rockwell Hardness (B and 30 T values) —are reported for six different tempers of each of the materials.

Symposium on Basic Effects of Environment on the Strength, Scaling and Embrittlement of Metals at High Temperatures. *ASTM Technical Publication No. 171. 6x9, 120 pp, paper. $2.75. American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa.*

Since most of the creep and creep-rupture tests from which design data on high-temperature alloys can be obtained are carried out in normal atmospheres, and since most high-temperature materials are used in atmospheres of water vapor or some products of combustion, the design engineer must always be concerned with the effects of the environment upon the creep rate and the ductility of the materials that he uses.

It was with the hope of contributing to the understanding of these effects that the

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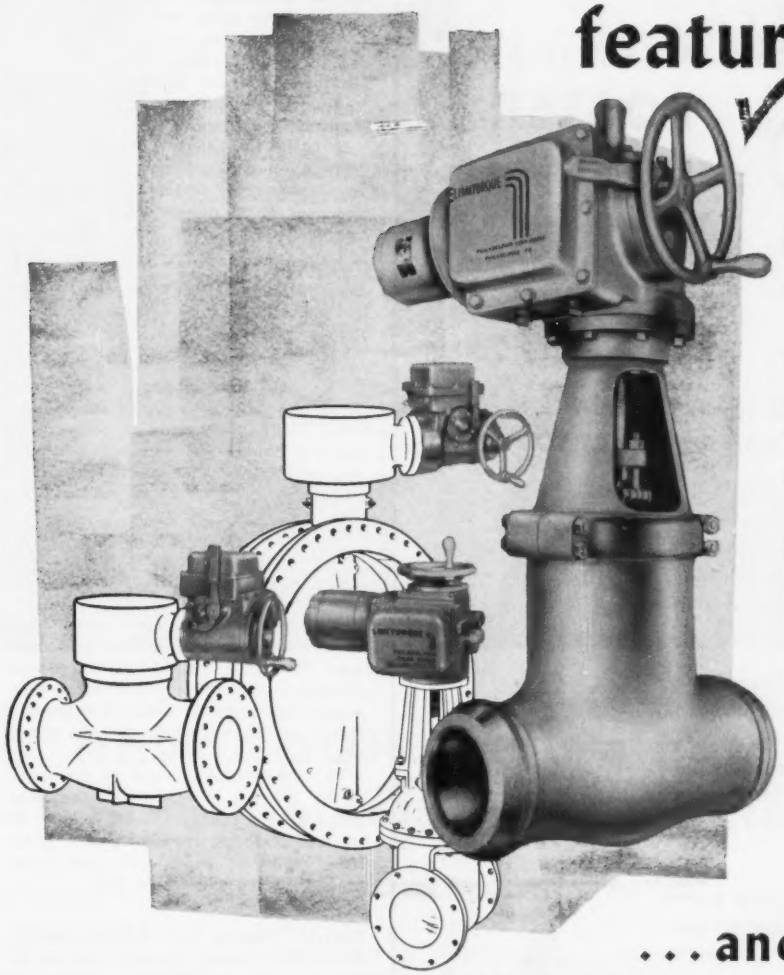

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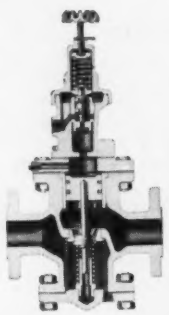

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More BOOKSHELF

Begins on page 248

General Research Panel of the ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals decided to sponsor this symposium. It was felt that there must be data on oxidation and surface effects and on creep under controlled atmospheres that the panel could collect in one publication, and that by so doing, further work in this field would be stimulated.

It is believed that the papers which make up this symposium represent accurately the status of the problem of environment at the present time.

Techniques of Plant Maintenance & Engineering—1956. *Published by Clapp & Poliak, Inc. 248 pp, illust. $10. Clapp & Poliak, Inc, 341 Madison Ave, New York 17, N.Y.*

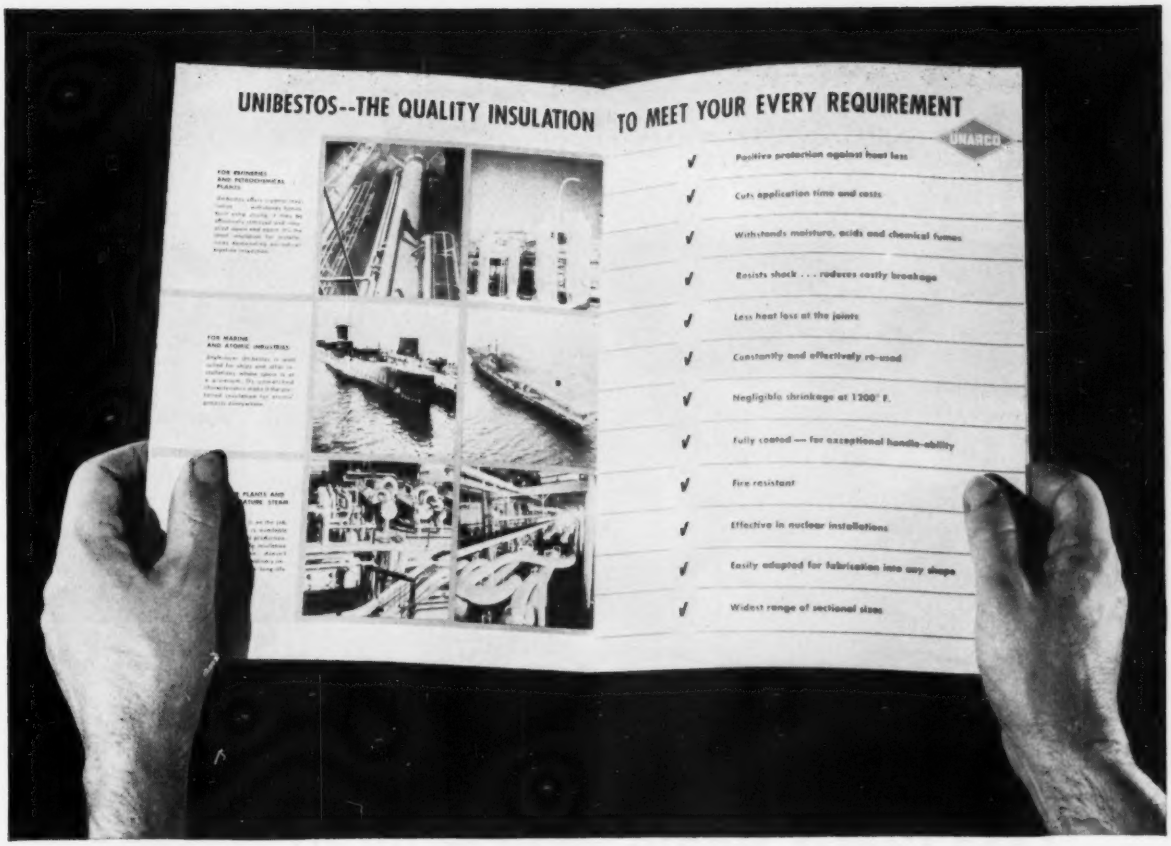
This book reports proceedings of the conference held with the Plant Maintenance and Engineering Show produced by Clapp & Poliak, and contains the text of 16 papers, summaries of 15 roundtable discussions and answers to approximately 1100 specific questions.

"Reports from the maintenance field indicate the growing influence of the maintenance manager in top management councils when new plants are designed, when equipment purchases are contemplated, when new production layouts are under way. Inevitably, too, his influence must increase still more as plants adopt automation, and excessive downtime becomes a luxury no plant can afford," the editors state.

This year's book, seventh in the series, is the broadest in scope. Five industries get special attention. These include air transparent shops, chemical plants, petroleum refineries, paper mills and paper product plants, and textile mills.

Electrical Testing and Troubleshooting. *By Philip T Green, industrial training coordinator, Panama Canal Co. 191 pp, illust, $4.00. The Industrial Press, 93 Worth St, New York 13, N. Y.*

This practical book on how to locate faults and correct them will be useful to anyone with responsibility of keeping plant's electrical equipment operating. It's clearly written and well illustrated. Test procedures are given that require simple, usually available, instruments and equipment. There are chapters on electrical symbols and drawings, analyzing and charting controller operation, troubleshooting test equipment, insulation testing, locating grounds, electromagnet windings, dc machine windings, single-phase and polyphase transformers, phase sequence, polyphase induction and synchronous motors, power cable faults and bearing lubrication. Comprehensive as it is, it doesn't completely cover subject of troubleshooting (as probably no book can), and you may find some of your favorite "tricks of the trade" omitted. The book is bound with a flexible and dirt-resistant cover.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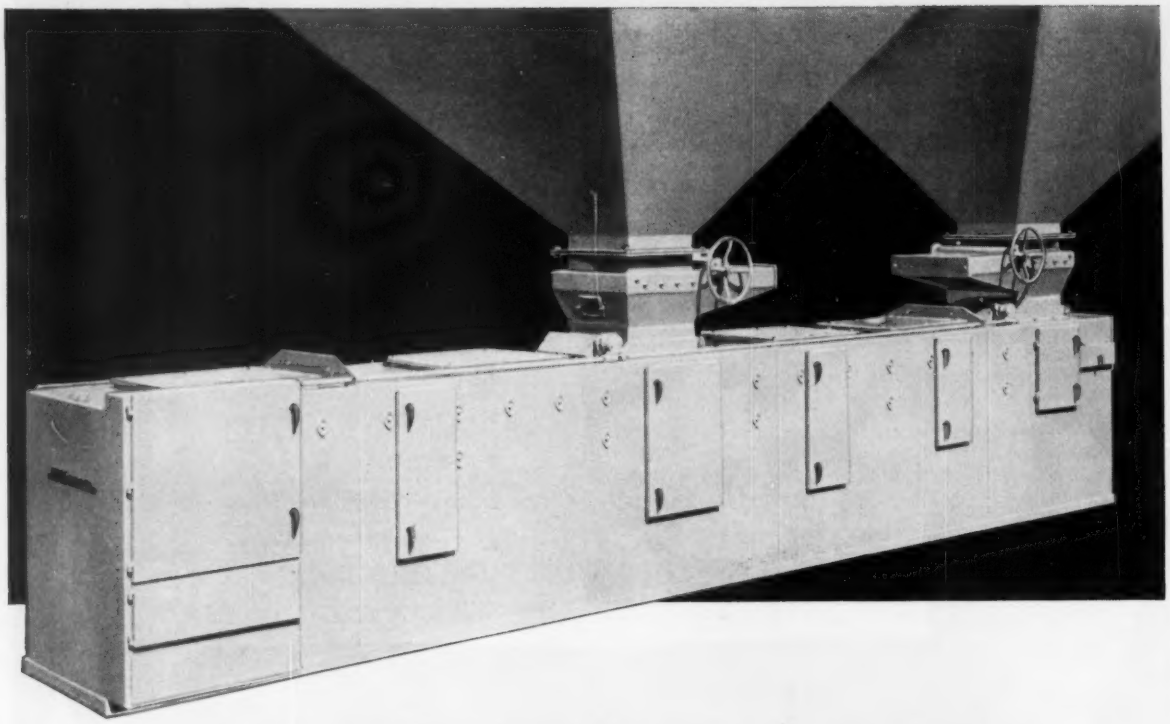

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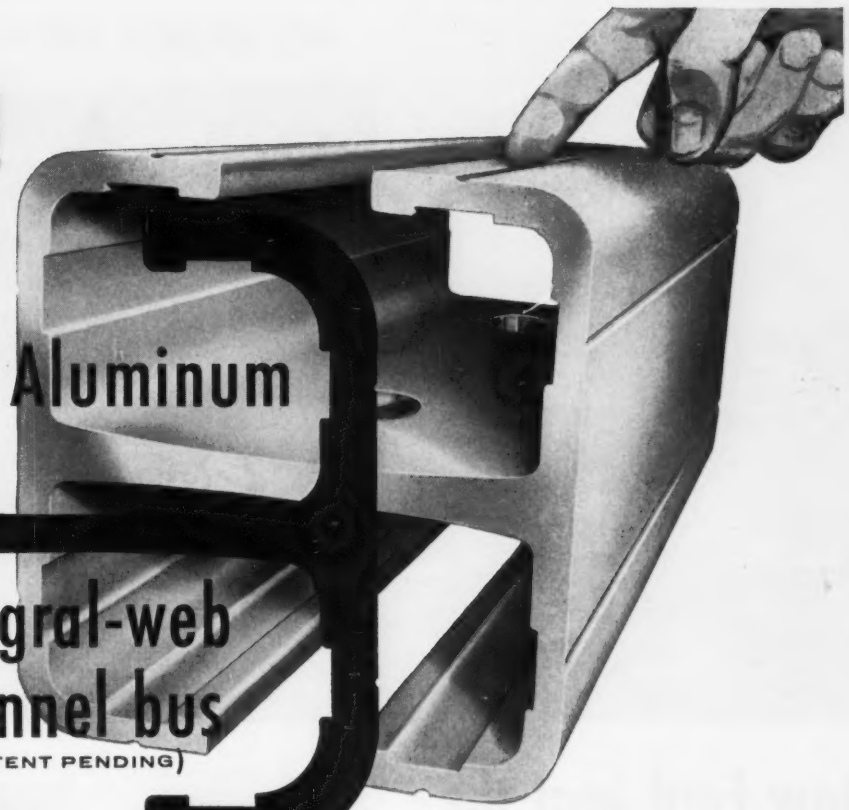

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Its integral-web construction eliminates need for spacer clamps or welded bars across channels. The special extruded shape gives a large surface area to accommodate high current in either ac or dc circuits. Its high section modulus provides the mechanical stiffness needed to resist the forces of short circuits without damage or distortion.

Joints, taps and splices can be clamped, bolted or welded. Special grooves mark exact center lines for drilling bolt holes so that nuts lock in recesses designed to eliminate back-up wrench. Channels, plus vent holes in center web, provide high degree of ventilation, cooling and drainage.

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5 x 6	4,000
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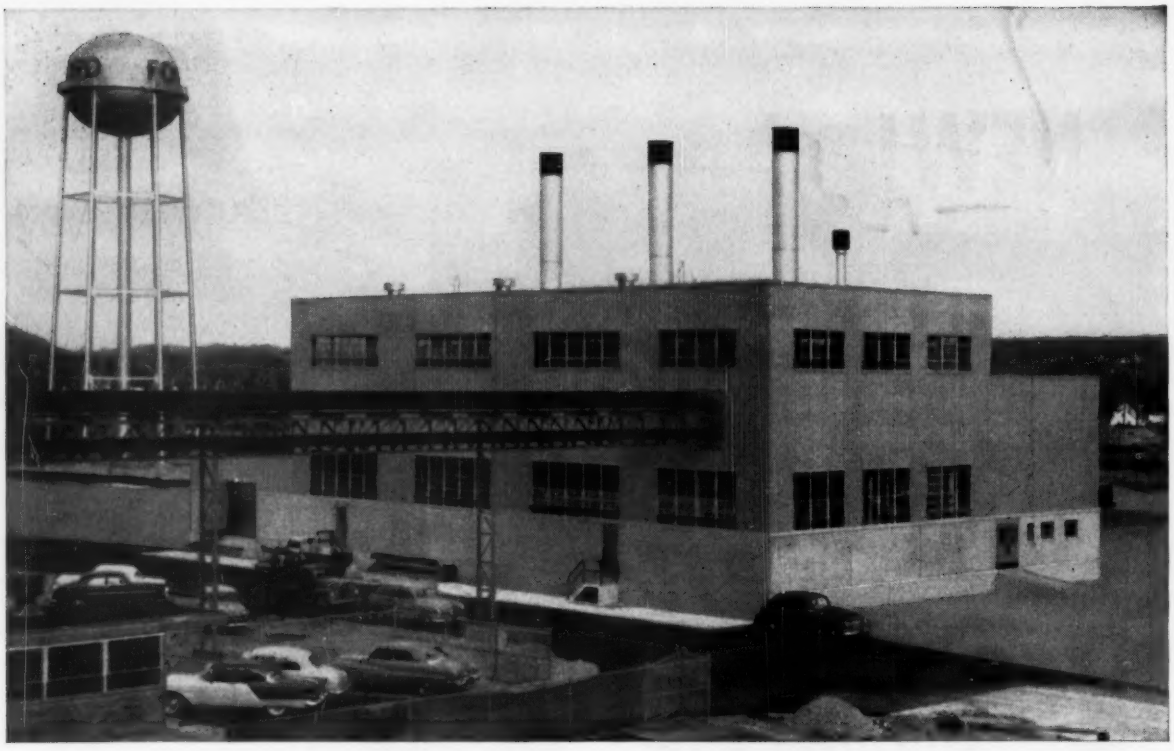

How Ford beat the construction *squeeze* at Mahwah

Steam and air flow from this boiler compressor building to meet production demands of Ford Motor Company's largest automobile assembly plant at Mahwah, N.J. Completed in 13 months, a safe margin ahead of the main assembly plant, it is a good example of how Dravo's "complete package" construction service can work for you.

When Ford engineers planned the construction of their mammoth new automobile assembly facility, they decided to minimize delay in putting the multi-million dollar plant in production by taking full advantage of outside construction services. Dravo's power plant construction specialists were called upon to handle the construction-engineering and construction of the boiler-compressor house. Working as a team, Ford specified the steam and air needed and left the construction planning and erection of the facility up to Dravo.

As a result of this teamwork, all material and equipment was on order within a month, field construction work started in three months and initial boiler operation in 13 months. But in addition to this saving in time, costs were also cut through the use of basementless construction and many other construction innovations. The complete plant contains three 132,000 lb/hr boilers and four 2400 cfm air compressors—all conveniently arranged on one operating level with centralized control.

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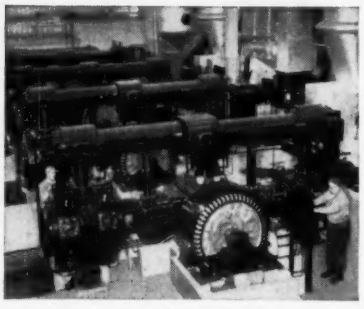
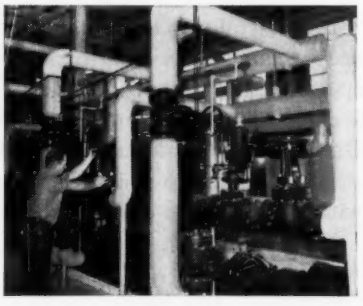


Four air compressors installed by Dravo supply the Ford assembly plant with 9,600 cu ft of air per minute.



Power piping for the boilers at Ford's Mahwah assembly plant was fabricated at Dravo's Marietta, Ohio, plant for erection on the site.

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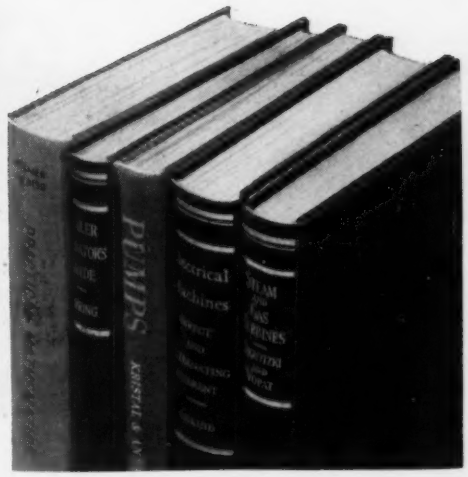

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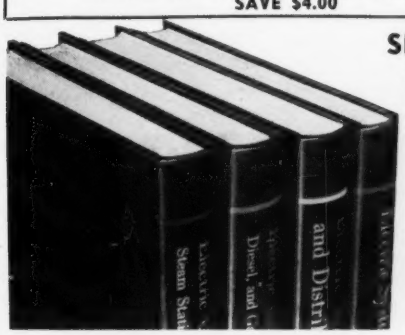

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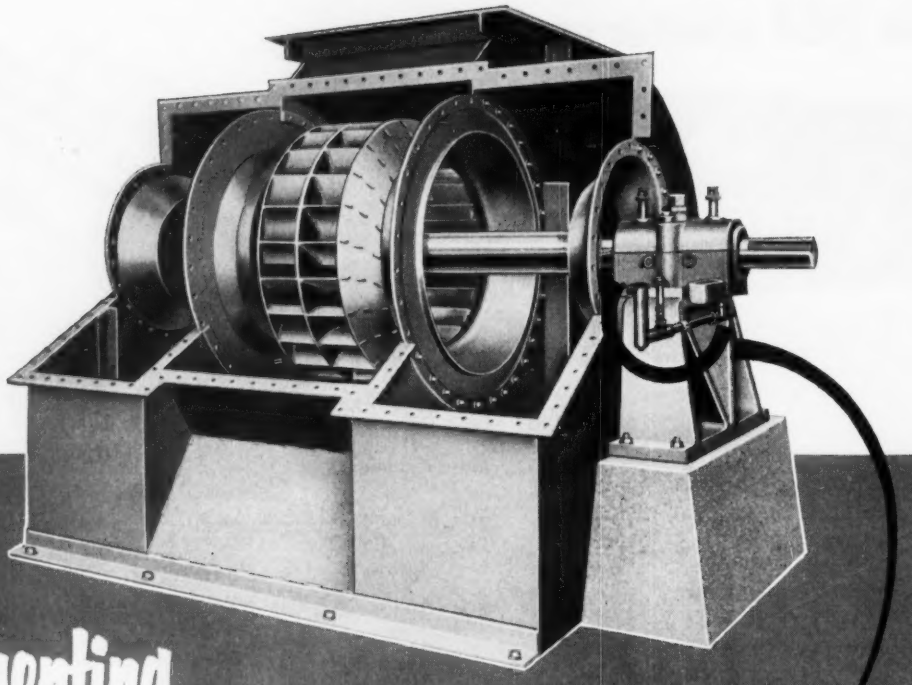
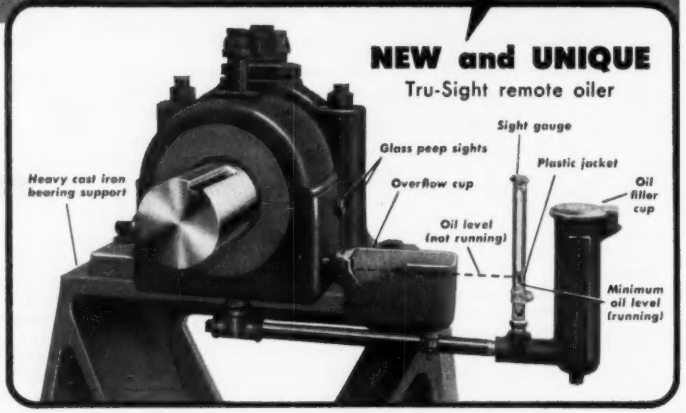
P-1



Presenting... Another of the features distinguishing CLARAGE MECHANICAL DRAFT FANS

You get more than extra-heavy construction, extra-long service life from a Clarage Fan. You now get a vastly superior oiling arrangement for the bearings — as shown on the right.

Send for Catalog 901-A describing the Clarage Type RT Fan and the many features that have made it the stand-out performer in forced and induced draft service. CLARAGE FAN COMPANY, Kalamazoo, Michigan.



Designed to simplify maintenance, this Clarage Oiler provides for accurate remote oil level indication when fan is running or not running . . . simplified oil level adjustment . . . quick filling . . . automatic overflow to prevent overfilling . . . cleanliness due to improved shaft seal effectiveness and use of overflow cup.

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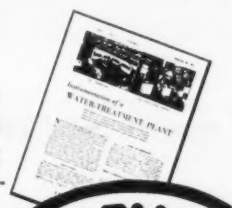

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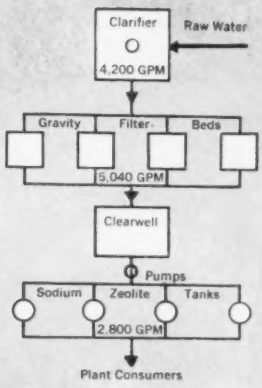

...MEASURES flow, maintains constant water level, keeps amounts of chemical proportional, removes sludge.

...EQUALIZES water passage by flow control and loss-of-head control, maintains same flow rate, controls backwash.

...PUMPS water to softening units and then meters it to five 175,000-lb./hr. boilers for steam generation.

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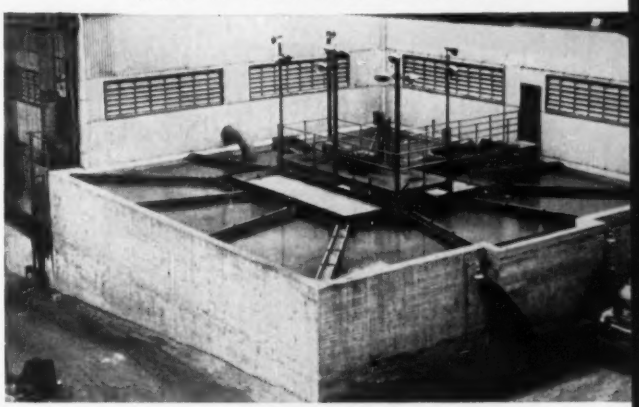
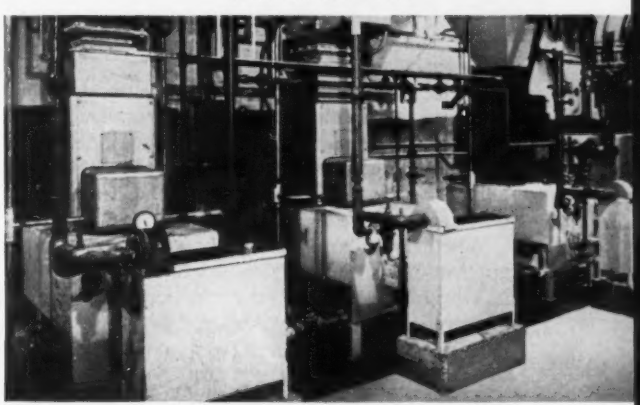
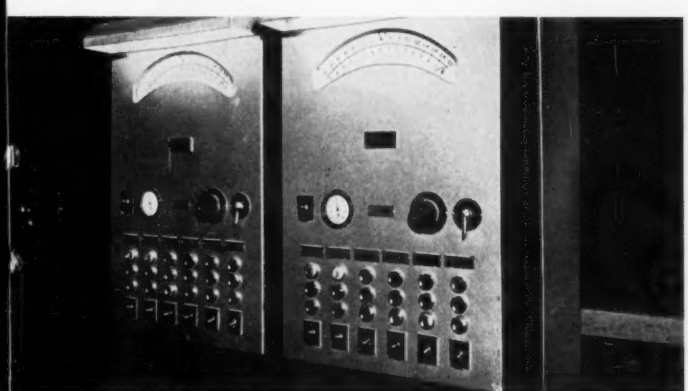


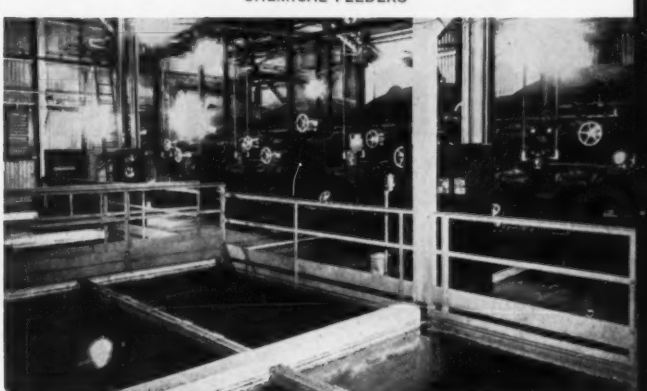
CLARIFICATION BASIN



CHEMICAL FEEDERS



FILTER BED CONTROL PANELS



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4130 alloy steel tube with alloy steel tip and socket.

403 stainless steel tube with alloy steel tip and socket.

403 stainless steel tube with 416 stainless tip and socket.

316 stainless steel tube with alloy steel tip and socket.

316 stainless steel tube with 303 stainless tip and socket.

Monel tube with alloy steel tip and socket.

Tubes and sockets listed above are available in Type 100 Mastergauges which are designed for extreme service and pressures. Type 101 Mastergauges, for medium and high pressures, are available with:

4130 alloy steel tube, with alloy steel tip and socket.

403 stainless steel tube, with 416 stainless steel tip and socket.

403 stainless steel tube with alloy steel tip and socket.

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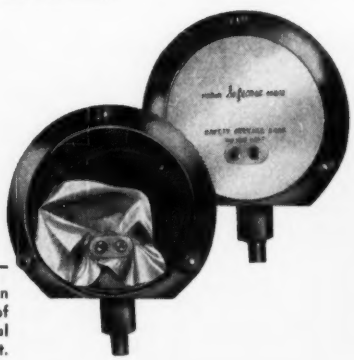

Explosive force merely opens safety back—

Photo shows result of laboratory test in which gun cartridge was discharged in rear compartment of Safecase. Thin, tough back yields to abnormal pressure, but cannot be dislodged by blowout. Front of gauge remains intact, protected by heavy metal barrier.

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Financial Aid to Higher Education

A Fine Start, But...

This editorial has two purposes. The first is to salute American business for the fine start it has made in helping to relieve the financial plight of our colleges and universities. The second purpose is to stress the importance of having business provide more financial aid, and soon.

How Business Helps Higher Education

Business contributions to higher education doubled between 1950 and 1955. They jumped from $40 million to $80 million. Preliminary figures indicate they will be even higher this year.

Business firms have also shown a lot of ingenuity in devising different ways of making their contributions. The methods range from a matching of an employee's contribution to his particular alma mater to wide diffusion of the money through state and regional money-raising associations of colleges and universities. Thanks to this ingenuity, business firms now have a wide choice of ways by which to give effective aid. The way most appreciated by college administrators is the making of gifts unrestricted as to the purpose for which the money is used.

Imposing as it is, however, what business has done thus far is only a good start. Only a tiny fraction of the total number of business firms in the country are giving direct financial help to our colleges and universities; and this fraction includes fewer than half of the hundred largest corporations in the country. Also, the amount of financial help being provided by business constitutes only a very small fraction of what is needed.

Why Colleges Need More Aid

Right now our privately endowed colleges and universities need about $350 million more in operating income a year than they are receiving to enable them to pay decent faculty salaries and be in tolerably good working order otherwise. The reasons, including a severe decline in the purchasing power of their endowment income because of price inflation, have been dealt with in the previous editorials in this series.

In addition, these institutions, together with the tax-supported schools, are faced with a tremendous increase in enrollment over the years ahead. With both a rapidly increasing population of young people and an increasing propor-

tion of them going to college, this year's enrollment of 3.2 million students is expected to reach 4.0 million by 1960, and to be doubled by 1970.

For the next ten years our privately supported colleges and universities must have an average of about $400 million a year above what they can be expected to collect from tuition fees, income from endowment funds, etc.

This figure of $400 million does not include what is needed for new buildings and equipment. It also does not include help for tax-supported schools above what they get from taxes, fees, etc. Business has given and will continue to give these schools substantial aid. Indeed, almost 25% of the financial help from business for our colleges and universities went to tax-supported schools in 1955.

If aid from business met their needs for increased operating income, the privately supported colleges and universities would be given a decisive lift in performing successfully their part in our system of higher education. They would still have large needs of capital equipment — buildings, dormitories, laboratories — but help from other sources, such as that provided by devoted alumni, where they are well organized, could be expected to go far toward meeting these needs. Also some companies prefer to concentrate on meeting needs of this type.

What 1% of Profits Would Do

But do business firms have the capacity to fill the gap in adequate operating income for our privately endowed colleges and universities without putting an excessive financial burden on themselves? Those who have studied this capacity carefully say that the answer clearly is yes. If, of its profits before taxes — this year an estimated $43 billion — business were to devote 1% to helping our privately endowed colleges, it would take care of present operating needs of about $350 million a year. And the balance of $80 million would be a big step in meeting their needs for new buildings and equipment, too.

About one half of a 1% contribution of this sort would, in effect, be made by the federal government. Up to a limit of 5%, contributions of this type are exempt from the federal corporate income tax. For corporations with incomes above $25,000 per year this tax is 52%.

It is clear that not all business firms are in shape to devote 1% of their profits to aid to higher education. Even in this year of record-breaking prosperity, many of them will have no profits at all. But if business generally would take 1% of pre-tax profits as a target or benchmark for financial help to our privately endowed colleges and universities these institutions would again have sturdy financial foundations.

Relatively this is a very small price to pay (1) to insure a continuing supply of competently trained young men and women and (2) to buttress our freedom by assuring the successful survival of the privately supported sector of our system of higher education.

This is one of a series of editorials prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments of particular concern to the business and professional community served by our industrial and technical publications.

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Donald C. McGraw

PRESIDENT

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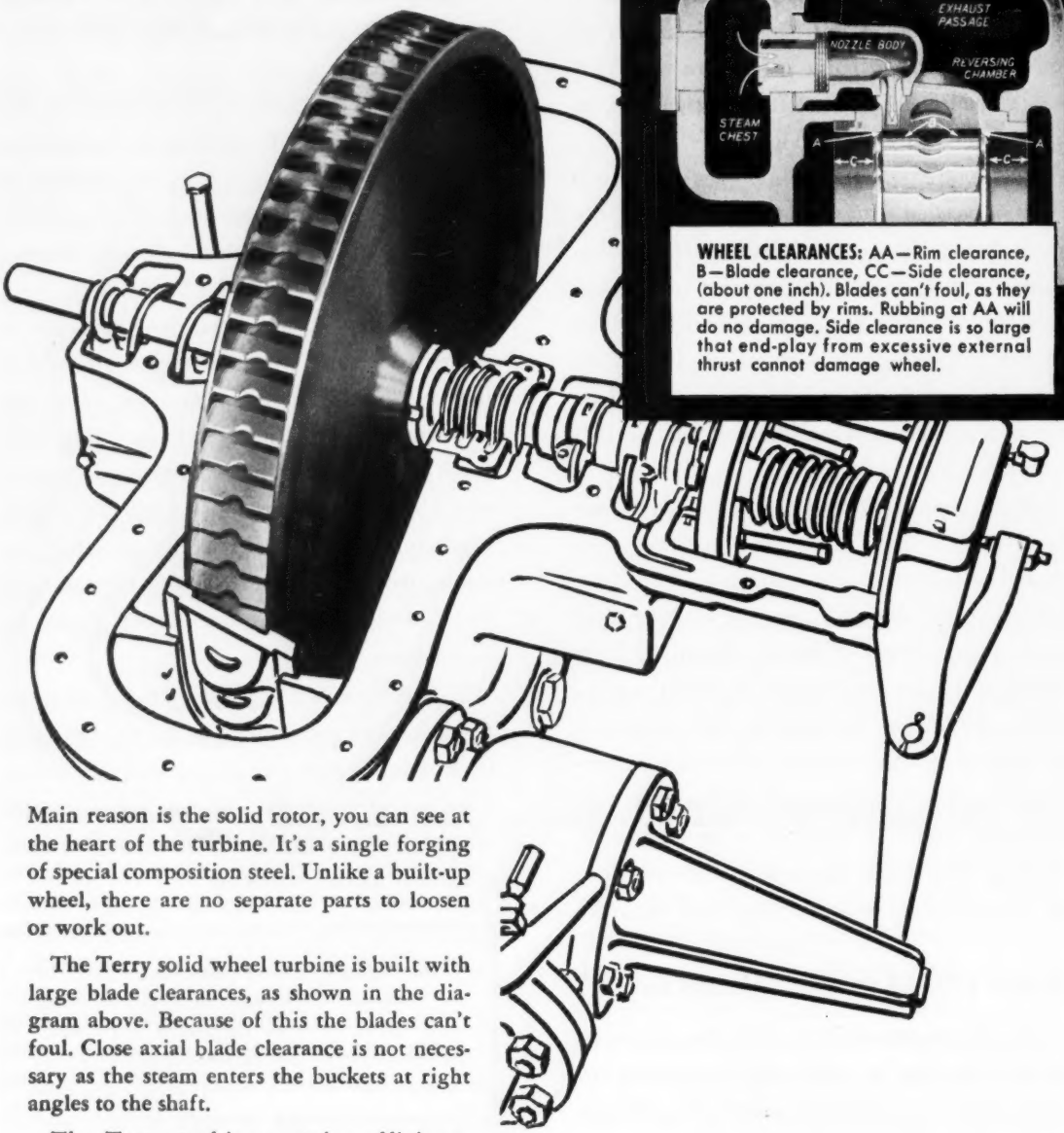
WHY TROUBLE GOES OUT

when this turbine goes in



WHEEL CLEARANCES: AA—Rim clearance, B—Blade clearance, CC—Side clearance, (about one inch). Blades can't foul, as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large that end-play from excessive external thrust cannot damage wheel.

Main reason is the solid rotor, you can see at the heart of the turbine. It's a single forging of special composition steel. Unlike a built-up wheel, there are no separate parts to loosen or work out.

The Terry solid wheel turbine is built with large blade clearances, as shown in the diagram above. Because of this the blades can't foul. Close axial blade clearance is not necessary as the steam enters the buckets at right angles to the shaft.

The Terry turbine sustains efficiency through the years. Reason: The power producing action of the steam takes place on the curved surfaces at the back of the buckets, so blade wear which might occur is of little consequence.

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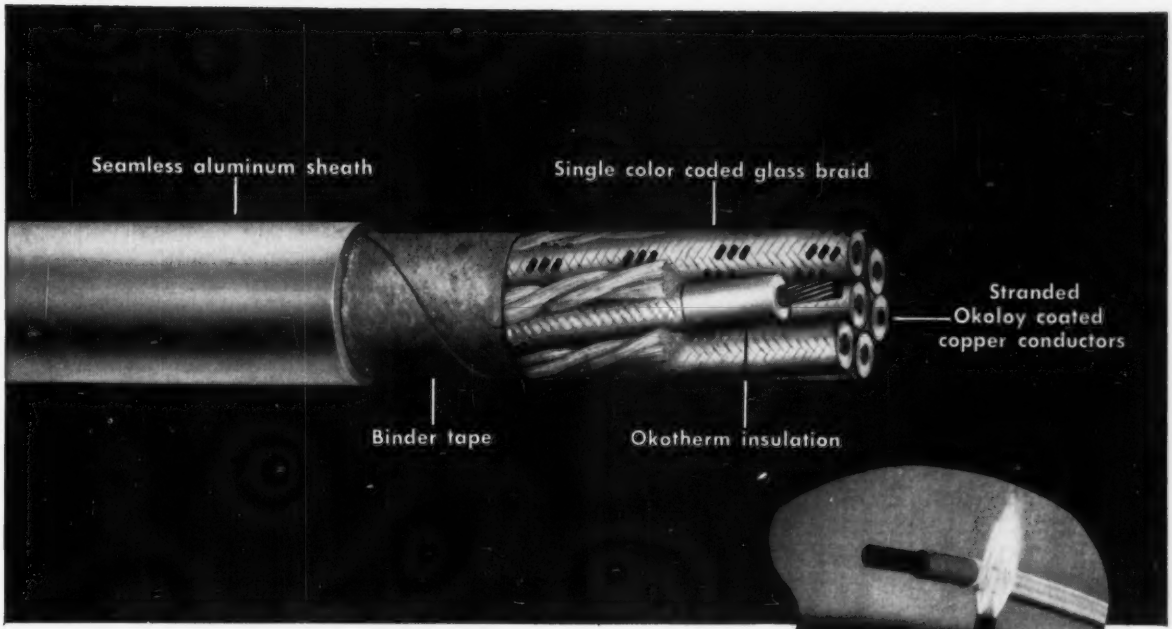

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P. O. Box 389
Baton Rouge, Louisiana

D. M. DUGUID
Technical Employment Dept.
The Dow Chemical Company
Freeport, Texas

DIVISIONAL SALES MANAGER

West Coast manufacturer of packaged steam generators has opening for Divisional Sales Manager to headquarter in or near Chicago. Territory covers eastern and southeastern states. Must have established sales managerial experience with jobbers and distributors. Good salary plus expenses. Requires considerable travel. Engineering background necessary. M.E. degree desirable. Preferred age: 35-45. Submit complete information in first letter. Qualified applicants will be interviewed in the territory. Reply:

P-3705, POWER
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UTILITIES ENGINEER

Chemical plant in Baltimore has opening for electrical or mechanical engineer to be in full charge of all steam and power production and distribution. Qualified to handle design and installation of power plant expansion.

Please send resume of training and experience to:

Personnel Department
Fairfield Chemical Division
FOOD MACHINERY & CHEMICAL CORP.
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MGR. of ENGINEERING $20-25,000
Direct large Engineering organization. Steel mill experience desirable.

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Submit resume in confidence or contact:

J. L. OVERHOLT **WAbash 2-5020**
Wabash Agency **202 S. State** **Chicago**

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NEW YORK: P. O. Box 12 (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

Superintendent, for modern, centralized controlled electric utility steam plant located in southwestern state. Qualifications: Technical education required and 5-10 years of responsible supervision of steam electric generating plants. In reply, state age, detailed experience, education, salary expected and availability date. All applications will be acknowledged. P-3467, Power.

Watch Engineer for municipally owned electric generating plant. Required preparation: High School graduate, supplemented by study along mechanical engineering lines, preferably with one or two years college work, and at least five years experience in a power plant. P-3724, Power.

SELLING OPPORTUNITIES OFFERED

Manufacturer's Representatives and Distributors —wanted to handle sales and service of miniature (¼ H.P. up to 5 H.P.) electric steam generators up to 100 lbs. pressure—each unit bearing a Registered National Board of Boiler and P. V. I. Number, individually inspected under the miniature boiler code. We have specialized in this field for 10 years and desire only men who know and work with steam, or equipment requiring steam for its operation. Please reply Box RW-3535, Power.

Water conditioning equipment manufacturer desires agents for New England, Upstate New York and Baltimore-Washington areas. RW-3789, Power.

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Established sales representative (three men), metropolitan New York City area desires additional line, preferably for industrial and, or, utility boilers. RA-2590, Power.

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POSITIONS WANTED

Engineer—33, technical school graduate 10 years experience steam and diesel power plant problems, operation and maintenance. PW-3583, Power.

Chief Engineer, age 35, married, technical education, 12 years experience in all phases of operation and maintenance of steam electric power plants. PW-3783, Power.

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BECHTEL

Offers you immediate long range engineering opportunity in

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Electrical Sub-Station
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Steam Electric Generating Station

Liberal relocation allowances for you and your family.

Send Resume to
Manager of Employment & Placement
Industrial Relations Division

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CORPORATION
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Paul Keating, MUrray Hill 7-7100, New York City
Joe Braddick, Fairfax 3-2401, Houston, Texas
Bill Milliagn, Tucker 1549, Los Angeles, Calif.
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Classified Advertising Division

BOX 12

POWER

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Send resumé to

BARNARD AND BURK, INC.

1023 Nicholson Drive

(P.O. Box 1470)

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Steam and Refrigeration

FULL CHARGE. Engineering degree preferred. New Jersey

GOLD SEAL required. Chemical Plant located Garfield, N. J.

All Employee benefits. Send complete resume & salary requirements to:

Director of Technical Personnel

Heyden Chemical Corp.

342 Madison Ave., N. Y. C.

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Engineering Department

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3500 KW MG SETS

5—3500 KW, 3 Unit, Allis-Chalmers, Motor Generator Sets. Each consisting of:

2—1750 KW, 250/350 Volts parallel, 500/700 Volts series, 514 RPM, 500 Amp, Type HCC, rated continuous at 40 Deg. C. Allis-Chalmers DC Generators with Class B Insulation, separately excited, direct connected in the center to:

1—5000 HP, 3730 KW, 13800 Volts (6900 Volts), 3 Phase, 60 Cycle, 514 RPM, 162 Amps, Allis-Chalmers, Synchronous Motor with Class B Insulation, rated continuous at 40 Deg. C. Rise.

The Motor Generator Set is equipped with a 40 KW 514 RPM, 250 Volt, DC Exciter and a 10 KW, 514 RPM, 250 Volt, Allis-Chalmers DC Exciter.

All mounted on a structural steel base approximately 27' long x 11' wide.

These Units are of the very latest type and desgn—condition excellent—were used only a short time—AC and DC Switchgear available.

For any additional information and price, please contact one of the following dealers closest to you:

DUQUESNE ELECTRIC & MFG. CO., 6428 Hamilton Avenue, Pittsburgh 6, Pa.

MOORHEAD ELECTRICAL MACHINERY CO., 120 Noblestown Rd., Oakdale (Pittsburgh District), Pennsylvania.

BRAZOS ENGINEERING CO., INC., P.O. Box 9114, Houston, Texas

T. B. MacCABE COMPANY, 4300 Clarissa Street, Philadelphia 40, Penna.

FOR SALE

1 WESTINGHOUSE 150 KW AC GENERATOR

3/60/600 volts direct connected to a 200 HP high speed Fitchburg Steam Engine.

PLYMOUTH SHOE CO.

Middleboro, Mass.

FOR SALE
MARLEY COOLING TOWER

Marley Double Flow Induced Draft Tower. Size 63' x 73' x 32', Capacity 13,000 G.P.M. 3 Fans 212' Dia., 202 R.P.M., Input HP. 18.4 Reversible Gear Reducers, 3—20 HP. 3 Phase 440 V. Motors. Initial operation 1952—Use Discontinued 1956 upon completion of River Intake. Bids will be received until 7:30 P.M., Feb. 11, 1957, at which time same will be opened.

Address Bids to M. R. Posey, Supt.

MUNICIPAL POWER & LIGHT

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SACRIFICE

100 Horsepower Clayton Steam Generator Complete —8 Years Old—Re-tubed two years ago—2500 gallon copper lined Hot Water Heater. **Contact WHITE ROSE LAUNDRY, 25-27 West 23 Street, Bayonne, N. J. Federal 9-6161.**

FOR SALE—GENERATOR

1—750 KW Westinghouse D.C. generator driven by Corliss engine; also, 1—350 generator. Both complete with switch gear.

Chief Engineer

CONRAD HILTON HOTEL
CHICAGO, ILLINOIS

50 K.W. USED M.G. SET

G. E Manufacture Generator 115/230 volts—3 wire—coupled to squirrel cage motor—220 volts—3 phase—60 cycles—1160 R.P.M.—Mounted Structural Steel Base — balancing transformer—D.C. panel and instruments—Reduced voltage motor starter—good condition—f.o.b. Gardiner—$2,000.00.

Write for further details to

YELLOWSTONE PARK CO.
Engineering Department
GARDINER, MONTANA

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6000/3000 HP. SYNCHRONOUS MOTOR

(General Electric type TSM-28 preferred)

W-3807, POWER
Classified Advertising Division
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We solicit your listings of Power equipment.

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Steam Engine Generator Sets • Turbines • Condensers • Generators • Boilers or Complete Power plants.

PAUL OBERMAN
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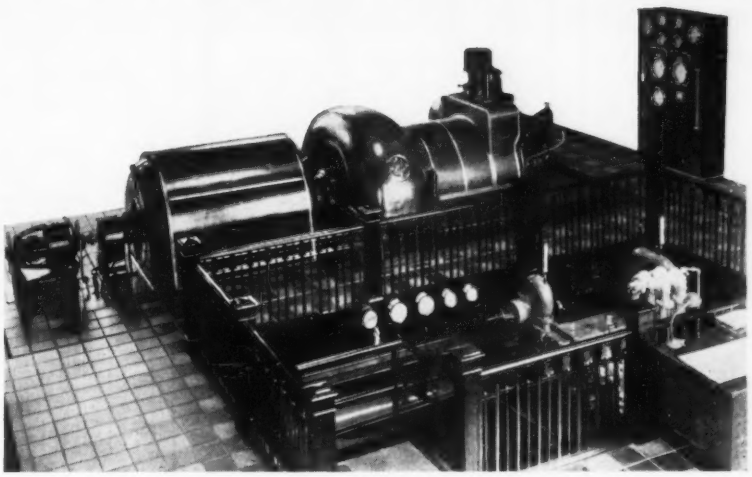
MODERN 400 LB., 750 DEG. TURBINE-GENERATOR:



The above G.E. 3750 KVA, 400#, 750 Deg. F. unit in excellent condition, complete. Generator 3/60/2300/4160 V.
We also have in stock: 3750 KVA, 440# PSIG, 750 Deg. FTT, 3/60/2300/4160 V., Condensing. 3125 KVA, 250/300# PSIG, (good for 400# with changes), 750 Deg. F. Automatic Extraction 50#, Condensing, 3/60/13,800 V.

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450-750 HP GAS ENGINES

LOT OF ALLISON ENGINES—
MODEL V-1710 12 CYLINDER—
ALL IN EXCELLENT CONDITION
SOME NEVER USED

Can be operated on Natural Gas, Butane, Gasoline, etc.

IMMEDIATE DELIVERY

PERRY EQUIPMENT CORP.
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ST 4-3505 **Phila. 22, Pa.**

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3 NEW BOILERS

Available at fraction of new cost

BABCOCK & WILCOX single uptake controlled superheat marine type express boilers, 3 drums, with economizers.

Designed pressure	634 lbs.	Steam temperature	850°F
Operating pressure	550 lbs.	Furnace volume	1473 cu. ft.
Superheated steam	221,000 lbs./hr.	Total generating surface	9338 sq. ft.
Saturated steam	32,000 lbs./hr.	Superheater surface	1620 sq. ft.
Full power total	253,000 lbs./hr.	Economizer surface	3843 sq. ft.

NOTE: These boilers are new and complete. They are erected and ready for use and should therefore be considered only for such places as can be reached by water transportation.

HUGO NEU CORPORATION

45 Nassau St. **Tel: REctor 2-1334** **New York 5, N. Y.**

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HI-PRESSURE
Complete stock from 10-2,000 h.p.
Nation's largest inventory. New & Used.
WABASH POWER EQUIPMENT
31 E. CONGRESS, CHICAGO 5, HA 7-4855

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3 15,000 KVA G.E. H-DHJ
1/60/132,000Y x 13,800
8.5% IMP. 4 taps above &/ below

Automatic tap changing under load
All steel cases #3196049-50-51

Excellent condition; very low price
F.O.B. Milwaukee

S. M. DAVIS
510 La Salle **St. Louis, Mo.**

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2—6000 CFM Ingersoll-Rand Type XHE—28 PSI size 31½ x 31½ x 14 Horz. Duplex, 600 HP, 300 RPM, 3 phase, 60 cycle, 4160 Volt, Unity P.F. complete with control panels—LATE—Condition excellent—immediate shipment.

2—New 200 HP Titusville—Iron Fireman Scotch Boiler—Burner Units, Heavy Oil Automatic 150 lb

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ESTABLISHED 1915

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Frank L. O'Brien, Jr., *President & Treasurer*

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LARGE ELEC. POWER EQUIPMENT SELECTED STOCK ITEMS

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COMBINATION MILL DRIVES — 15/2500 HP

D.C. MOTORS WITH M.G. SETS & CONTROLS

Qu.		MAKE	TYPE	VOLTS	R.P.M.
1—2200	HP	G.E.	MCF-12	600	400/500
2200	1 KW	G.E.	Syn.	2300/4600	514
1—1250	HP	G.E.	MCF	600	600/750
1000	KW	G.E.	Syn.	2300/4600	720
1—1000	HP	G.E.	MCF-8	600	350/700
1000	KW	G.E.	Syn.	2300/4160	720
1— 225		Whse.	SK-185	375	950/1200
1— 200	KW	Whse.	Sq. Cage	440	1200

ALSO MANY OTHER COMBINATIONS

A. C. MOTORS—3 Ph. 60 Cy.

SLIP RING

Qu.	H.P.	Make	Type	Volts	Speed
2	1750	G.E.	M-579BS	4800/2400	1800
1	1500	G.E.	MT	6600	257
1	1500	G.E.	MT	6900	1187
1	1100	F.M.BB	SF806S	4800/2400	1800
1	1000	A.C.	Mill	2300	240
1	800	G.E.	MT	2300	293
1	750	G.E.	MT-573	2200	1190
1	700	Al. Ch.	D.P.	2300	500
1	500	Whse.	CW	550	350
1	400	Whse.	CW	440	514
1	350	Cr. Wh.	SIZE-290	2300	350
1	350	G.E.	IM-17A	440/2200	720
1	250	G.E.	MT-424Y	4000	257
1	250	A.C.		550	600
1	200	G.E.	IM	2200	580
1	200	G.E.	MT-557Y	220	1760
1	150	Whse.	CW26E17	2300	435
2	125	A.C.	ANY	440	865

SQUIRREL CAGE

1	800	G.E.	KT-573	2200	1180
2	650	G.E.	FT-559BY	440	3570
2	450	Whse.	CS-1420	2300/4150	354
1	400	G.E.	IE-15B	2300	1165
1	400	G.E.	1K	2200	500
1	200	G.E.	1K-17	440	580
3	200	G.E.	KT-557	440	1800
1	150	Whse.	CS	440	580

SYNCHRONOUS

1	7000	G.E.	ATI	2240/6600	600
1	4350	C.W.	3501-SL	13800/6900	514
2	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	900
2	2000	Whse.		2300	120
1	1100	G.E.	ATI	2300/4600	900
1	500	G.E.	TS-7567	2200	1200
2	350	G.E.	TS	2200	150

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2000/2400	G.E.	450	250/300	2300/4600
1	2000	G.E.	500-25cg	650	11000
2	2000	G.E.	514	600	4600/2300
1	1750/2100	G.E.	514	250/300	4800/2400
1	1500	G.E.	720	600	6600/13200
1	1500	G.E.	514	250	2300/4600
1	1000	G.E.	900	260	6600
3	1000	G.E.	720	600	6600/13200
1	750	G.E.	720	275	6600/13200
1	750	G.E.	720	125/250	2300/4600
1	500	Whse.	900	125/250	440
3	300	G.E.	1200	250	2300
1	150	Whse.	1200	275	2300

WELDING M.G. SET

Gen. Elec.—1100 Kva 0.7 p.f.—2300/4600 V. 3/60 Generator with 1750 Kva—.8 p.f.—2300 V. 3/60 motor complete with exciter set and controls.

TRANSFORMERS

Qu.	KVA	Make	Type	Ph.	Voltage
1	3000	A. C.	OISC	3	33000x2400/4160
1	2500	Al. Ch.	OISC	3	34500x13800
1	2500	Al. Ch.	Fur.	3	13800x147/113
3	1000	G.E.	OISC	1	13800x230/460
3	500	G.E.	HD	1	4800/2400/480
3	500	Kuhl	OISC	1	13800x6900
3	333	G.E.	H	1	6900x230/460
3	333	G.E.	OISC	3	4160/480/270Y
3	250	L.M.	OISC	1	14400/13800/240/120

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltage
1	5000	G.E.	60/50/60	6600/11000/6600
2	2500	G.E.	25/62.5	2300/2300
1	1000	G.E.	25/58.3	4400/2300
1	500	Al. Ch.	25/60	11000/2300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G.E.	Condensing 425 — 750 F.T.T. Surface Condenser 3/60/2300/4000 V Direct con exciter.
1	1500	Whse.	Auto extraction 190 lbs. — 660° F.T.T. 60 lb. extraction 3/60/240 V. Div. Conn. Exc.
1	1000	Moore	Auto-Ext. Cond. 175200# U.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300. Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 430/3/60.

BELYEA COMPANY, INC.

43 Howell St., Jersey City 6, N. J.

37 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
800	2300	Whse.	900
500	4000/2300	G.E.	600
450	440	Whse.	514
400(2)	2300	G.E.	900
400	2200	Whse.	450
300	4000/2300	G.E.	720
300	440	G.E. (hoist)	600
300	440	Whse.	3500
250	2200/440	G.E.	1200
250	440/220	Whse.	600
250	550/440	G.E.	1200
225	4000/2300	G.E. (hoist)	600
200	440/220	Whse.	514
200	2200/440	G.E.	600
150	440/220	Whse.	720
150	2200/440	G.E.	600
125	2200	G.E.	600

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G.E.	ATI	720
375	2200	Whse.	G	900
350	440/220	El. Machy.	Syn.	1200
300	2300/600	G.E.	TS	720
300	2200/440	G.E.	TS	1200
250	440/220	G.E.	ATI	600
150	440/220	G.E.	TS	720
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2200	G.E.	FT	3600
500	2300/4000	Elliot	SC	1800
350	440	G.E.	KT	1200
300(2)	2200	G.E.	FT	3600
300	2300/4000	L. Allis	FS	1800
250	440/220	G.E.	KT	720
250	2300	Whse.	CS	600
200	440/220	G.E.	KT	1800
200	2200	G.E.	KT	1800
150	2200	Al. Chal.	AR	1800
150	440/220	G.E.	KT	720
150	2200/440		KT	600
150	2200/440	G.E.	FT	1200
125(2)	2200/440	Whse.	X-proof	720
125	2200/440	G.E.	K	600
100(2)	4000/2300	L. Allis	OX	1200

A. C. GENERATORS

1—320 kva, 660 rpm 2300/440/220 V., G.E.
1—300 kva, 900 rpm, 2200 V., Whse.
1—225 kva, 60 rpm, 230/440 V., G.E.
1—200 kva, 720 rpm, 2300/440 V., G.E. (Ball)
1—187 kva, 1200 rpm, 2200/440 V., Whse.

CIRCUIT BREAKERS

2—2000 amp. GG E., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-155-28, 600 amp., 15,000 V. G.E.
1—400 Amp., Condit, 3P. 25 KV outdoor
1—400 Amp., R. Smith, 3P, 7.5 KV outdoor

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
225	230	Whse.	SK	1800
150	230	El. Dyn.	B/brg.	600
150	230	Whse.	SK	1750

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	2200	Syn.	250
150	Whse.	440/220	Sq. Ca.	275
125	G.E.	4000/440	Syn.	125
75	Cr. Wh. (unused)	440/220	Sq. Ca.	240/120
65	G.E.	2200/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—1000 kva, Whse., 13,800—2300 V., 3 ph., New
1— 600 kva, Standard, 13,800—2300 V., 3 ph.
3— 500 kva, G.E., 13,800—2300 V.
3— 333 kva, G.E., 13,800—2300 V.
3— 333 kva, G.E., 2400—480 V.
2— 300 kva, G.E., 4150—240 V., 3 ph., Pyr.
3— 200 kva, G.E., 2400—120/240 V.
3— 200 kva, Mol., 13,800—2300 V.
3— 150 kva, Al. Ch., 2400—220 V.
3— 150 kva, Al. Ch., 440-220 V., dry, New
3— 100 kva, Al. Ch., 440-220/110 V., dry, New

only partial listing

STEPHEN HALL & CO.

HARRY J. RICE, Pres.

625 ADAMS ST., HOBOKEN 2, N. J.

3750-KVA G.E., 400#, 750°F., Cond. New, 1941.

3750-KVA. ELLIOT, 440#, 750°F., Cond., 2300/4160-V. New, 1940.

3125-KVA., 250/300#, 750°F., Aut. Extr. 50# Cond. New, 1942.

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Direct Synchronous Motor Driven with regulators, intercoolers, air-maze filter, silencer, Manzel mechanical lubricators, aftercoolers, essential piping, valves, air receiver.

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40,000 LB. RILEY, 260 PSI.

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4' x 135' STEEL STACKS.

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5000 KVA TURBO GENERATOR, condensing, 450 PSI.

200 KW MG SET, 250 Volts DC 2300/3/60, with panels.

6300 sq. ft. CONDENSER.

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628 CFM TYPE ESI, I.R. COMPRESSOR 100 PSI, 100 HP Motor.

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HP	Mfr.	Type	Volts	Speed
300	Allis Ch. b.b.	EW	350	1000
200	Marathon b.b.	DCD	230	1750
200	Allis Ch. b.b.	EW	250	600/900
175	Cr. Wh.	151-H	230	500
150	Whse.	SK-184	230	850
100	Reliance	651-T	550	1000/1600
100	Reliance	651-T	230	575/1150
100	G.E. dynamom.	TLC-50	230	1000/4000
100	Elliott b.b. T.E.	JH-FE	230	1150
75/150	Whse.	SK-200	230	400/1000
75	Century	R-92	230	690/1350
75	F. Morse b.b.	DH-140	115	1600
60	G.E. TEFC b.b.	CD-135	230	1150
50	G.E. (3)	CD-125	230	400/1200
40	Reliance b.b.	131-T	550	1750
40	G.E. (2)	CD-93	230	1750

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V.
300	Gen. Elec.	2200/440 AC	260 DC
200	Whse.*	220/440 AC	55 DC
200	Gen. Elec.*	220/440 AC	125 DC
200	Whse.	2300 AC	250 DC
175	Gen. Elec.	220/440 AC	250 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
100	G.E.*	2200/440 AC	125 DC
100	Whse.	220/440 AC	250 DC
75	G.E. converter	440 AC	250 DC
75	G.E.	220/440 AC	125 DC
60	Whse.	220/440 AC	250 DC
50	Gen. Elec	220/440 AC	125 DC
50	Cr. Wh. b.b. (2)	220/440 AC	250 DC
35	Gen. Elec.	220/440 AC	125/250 DC

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	G.E. (2)	CY-275	260	1200
250	Allis Ch. b.b.	EW	350	1200
200	Allis Ch. b.b.	EW	250	900
150	Whse.	SK-184	250	1150
150	Cr. Wh.	CCD	250	650
100	Whse.	SK-180	250	900
100	Allis Ch.	E	125	1200
100	Reliance	651-T	600	1200
75	F. Morse b.b.	DG	125	1800
60	Allis Ch. (3)	E-146	250	1500

A. C. MOTORS — 60 CYCLE

HP	Mfr.	Type	Volts	Speed
700	G.E.	Slipring	220/440	1800
600	G.E.	Slipring	2300	600
500	Whse.	Slipring	2200	450
450	Allis Ch.	Synch.	480	400
400	Whse. (2)	Synch.	2200	1800
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2200	3600
400	Whse.	Sq. Cage	2200/440	1200
350	G.E.	Sq. Cage	2200	1800
350	Cont. b.b.	Slipring	2300	900
300	El. Mchy (2)	Synch.	2200/440	360
300	Whse.	Synch.	440	1200
300	G.E.	Slipring	440	450
300	Allis Ch.	Sq. Cage	2200/440	720
250	G.E.	Slipring	440	1800
250	G.E.	Sq. Cage	2200/440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E.	Slipring	220/440	720
250	Gen. Elec.	Synch.	220/440	450
250	Whse.	Slipring	440	1200
250	G.E.	Sq. Cage	2200	1800
250	Allis Ch.	Synch.	440	360
225	G.E.	Synch.	220/440	900
200	G.E.	Sq. Cage	2200/440	1200
200	Whse. (2)	Slipring	2200	514
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	440	450
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	G.E. (2)	Sq. Cage	2200	514
175	G.E. (2)	Synch.	220/440	720
150	El. Machy.	Synch.	220/440	360
150	G.E. (4)	Slipring	2200/440	600
150	G.E. (3)	Sq. Cage	2200/440	720
150	Cr. Wheeler	Sq. Cage	220/440	450
150	G.E.	Slip Ring	220/440	450
125	Whse. TEFC	Sq. Cage	2200/440	720
125	G.E. TEFC	Sq. Cage	220/440	3600
125	Ideal	Slipring	4000/2200	900
100	Whse. TEFC	Sq. Cage	2200/440	1200
100	Whse. (2)	Sq. Cage	2200	900

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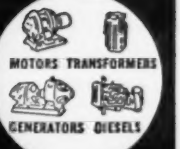

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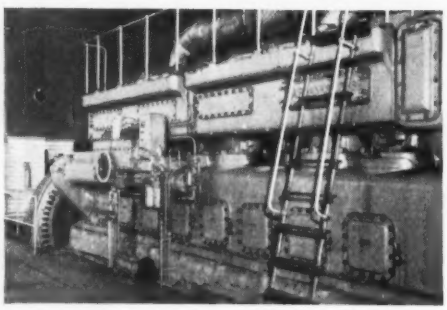

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Either C. H. Wheeler or Westinghouse. Type 4H55. Capacity 12 lbs. air/hr. Operating steam pressure 275 lbs. gauge.

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(1) G.E.—1375 HP at 415 volts DC—2-bearing ball-bearing—1375 RPM.

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1875 KW MOTOR GENERATOR SET

1875 KW General Electric generator, 250 volts direct current, direct connected 2600 HP General Electric synchronous motor, 3 phase, 60 cycle, 11,000 volts, 600 RPM, complete with automatic switchgear. Excellent condition.

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SLIP RING MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
2000	*G.E.	MT	257
1500	*Westg.	CW	600
1200	*Al.-Ch.	ANT	1800
600	*G.E.	MT	450
500	Westg.	CW	600
300	G.E.	IM-17B	600
250	*G.E.	IM	720
200	G.E.	IM	600
200	Westg. (2)	CW	514
200	*Westg.	CW-905A	514
150	Cr.-Wh.	50-R	1800
150	Westg.	CW	450
125	G.E. (2)	IM-15A	600
100	G.E.	IM-13A	1800
100	G.E.	MTC-5546	900
100	G.E.	IM	720
100	G.E.	IM	600
100	G.E.	IM-15A	450
75	G.E.	MT-347	1200
75	G.E.	IM	1200
75	Al.-Ch.	ARY-223C	1200
75	G.E.	MT-356	900
75	Al.-Ch.	ANY-26F	900
75	Al.-Ch.	ARY	720
75	G.E.	MT-352	720
75	G.E.	MT-556	720
75	G.E.	IM	600
60	Al.-Ch.	ARY	1200
60	G.E.	MT-545	1200
60	*G.E.	MT-536	1200
60	*Westg.	CW762C	900
50	Westg.	CW	1800
50	G.E.	IM-11A	1800
50	*Al.-Ch.	ARY	1200
50	Westg.	CW636A	1200
50	*G.E.	MT-536	1200

SLIP RING MOTORS

Crane & Hoist Service
3 phase, 60 cycle, 220 or 440 volts

H.P.	MAKE	TYPE	SPEED
80	G.E.	MTC-5532	600
75	Westg.	CI-756A	600
50	Westg.	MW-334	600
50	G.E.	HIC-TENV	600
35	G.E.	MTCV-5536	600
20	Westg.	CI	1200
11	Westg.	CI-E464	900
10	P & H	BW-6	1800
5	P & H	BW-6	1200
5	N. West.	WRC	1200
3	G.E.	MTC-5944	900

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H.P.	MAKE	TYPE	SPEED
125	G.E. Cradle	TLC-20	2700/6000
150(3)	G.E. Cradle	TLC-50	2500/5000
200	Westg.-Block	SK-151	1350/4000

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AMPS.	MAKE	VOLTS
7500/3750	Elec. Prod.	6/12—220/440
2000/1000	Chandy.	6/12—220/440
1500/750	Chandy.	12/24—220/440
1500/750	Chandy.	6/12—220/440
1000/500	Chandy.	12/24—220/440

SQUIRREL CAGE MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
1250	*Al-Ch. (3)	ANX	3600
1200	*Al-Ch.	ARW	1200
750	*Westg.	CS	900
500	*Al-Ch.	ARW	3600
500	*G.E.	KT569S	900
500	G.E.	KT-424	450
350	*G.E.	KT-559A	1800
250	Westg.	CS-8120S TEFC	1800
250	G.E. (2)	KT-559	1800
250	*L-Allis	OEX-148	720
250	*G.E.	IK	600
250	G.E.	IK-17A	600
250	Westg.	CS-14	514
200	*G.E.	FT-549Y	3600
200	*G.E.	IK-13B	1800
200	G.E.	KT-564	900
200	*Westg.	CS-930A	900
200	G.E. (2)	KR-564S	720
200	Al-Ch.	ARWWT	600
150	G.E.	IE-13B	1200
150	*Al-Ch.	AN-30F	1200
150	G.E.	IK-15A	900
150	*Westg.	CS	600
125	Westg.	CS-771 Sppf	1800
125	*Al-Ch.	AR	1800
125	Westg. (2)	CS-761S	1750
125	Cr. Wh. (2)	Size 50R	1200
125	*Reliance	AA 6085	900
125	Al. Chal.	AN	514
100	Westg.	CS5075 TEFC	3600
100	*Westg.	CS-760A	1800
100	*G.E.	FT-542Z	1800
100	G.E.	FTRP-543	1800
100	*Westg.	CS-760D	1200
100	G.E.	KT-553	1200

D. C. MOTORS

H.P.	MAKE	TYPE	SPEED
250	Westg.	SK-220	450/600
200	Reliance (2)	1400T	350/1200
200	Westg.	SK-201	650
200	Cr. Wh.	CM	500
175	G.E.	ELC	750
100	G.E.	MPC	400/800
100	G.E.	RC-34	2500
100	G.E.	RC-19	575
100/150	G.E.	MCF	380/1000
50	Cr. Wh.	CMC	700/1100
35	Westg. (2)	SK150	350/1000
30	Cr. Wh.	CCM-504	450
30/40	G.E. (2)	CD-123	400/1600
30/40	G.E.	CD-115	500/1500
25/30	G.E. (2)	RF-12	500/1500
25	G.E.	RC-32	800
25	Westg.	SK-133	575
20/25	Westg.	SK-151L	250/1000

M.G. SETS

K.W.	MAKE	A.C.	D.C.
1250	Westg.	6600/4160	600
1000	G.E.	12000	600
500	Westg.	2300	125/250
400	A.C.	2300	120/240
300	Westg.	2300/440	250
200	G.E.	2300	250/275
200	Westg.	2300/4000	250/275
200	Ridgeway	2300	250
170	G.E.	440	125
150	G.E.	2300	125/250
150	A.C.	2300	275
150	Westg.	2300	125/250
150	G.E	440	275
125	Cr. Wh. (3)	4160	125
100	G.E.	2300	250
100	Al-Ch.	2300	250
100	Elec. Mch.	440	125

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1600 GPM, 1500 PSI, each powered by 1000 HP, 3 ph., 2400 VO. Westinghouse motor with GE switchboard, panels, etc.

54 Misc. Valves, 4" to 14", up to 600 Lb. pressure.

2 Steel Fuel Oil Tanks, 125,000 gal. cap. 35' x 18' high.

2 Steel Corrugated Bldgs., 40' x 40', and 20' x 30'.

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138 CFM	100 PSI	7x7 Ingersoll ESI
234 CFM	100 PSI	9x9x9 Chicago St. (new)
268 CFM	500 PSI	10-4½x10 Ingersoll XOB
284 CFM	100 PSI	Chic. PE 450 HP
343 CFM	500 PSI	11-5x13 Worth. (new frame)
464 CFM	100 PSI	12x11 Worth HB
552 CFM	100 PSI	13-8"12 Ingersoll XRB
502 CFM	125 PSI	12x13 Chic T
676 CFM	100 PSI	15-9½x12 Worth
1546 CFM	100 PSI	21-12½x14 CP—OCE 250 HP Syn 3-60-2400 .8 PF (1950)
1600 CFM	40 PSI	Fuller Rotary—Syn.
1723 CFM	110 PSI	140 lbs. at Ingersoll XPV
2018 CFM	Vacuum	28x11 Ing ER

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Rebuilt HEMPHILL Guaranteed EQUIPMENT

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
2	750	G.E.	H	1	4600-120/240
1	750	G.E.	HT	3	4150Y-220/440
2	250	G.E.	H Pyranol	1	2400-4800/8320Y-120/240
2	250	West.		1	2300/4600-230/460
3	200	G.E.	H-KD	1	13800/12420/4600-240/480
3	200	G.E.	H	1	7800/15600-220/440
1	150	Eisler	OA	1	4160-240/480
3	150	West.	S	1	2400/4160-460/230/115
3	50	G.E.	HS	1	2400/4160-240/480
2	37½	West.	Hypersil	1	2400/4160-240/480
1	25	G.E.	H Pyranol	1	2400/4160Y-120/240
6	15	Maloney	KL	1	2400/4160Y-120/240

SYNCHRONOUS MOTORS

Qu	HP	Make	Speed	Type	Volts
1	100	G.E.	900	TS	2300
1	125	G.E.	600	TS	2300
1	125	E.M.	900		4800
1	150	G.E.	1800	TS	220/440
2	150	Allis-Ch.	360		2200
1	150	West.	900		220
1	300	E.M.	720	TEFC	2300
1	500	West.	450	HR	440
1	1000	West.	360	Mill	2300/4150

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
1	15	G.E.	900	MT-542	440
1	25	G.E.	900	MT-526	440
1	60	G.E.	1800	MT	220
1	60	Ideal	900	AV	220
1	75	G.E.	600	IM	440
3	150	Allis-Ch.	1800	AY RW	2300
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	350	West.	1800	CW	2300
1	500	G.E.	1200	M	2400/4150

SQUIRREL CAGE

Qu	HP	Make	Speed	Type	Volts
1	40	Wagner	1750	CP TEFC	220/440
2	50	Wagner	1160	CP TEFC	220/440
1	25	G.E.	1170	405TEFC	220/440
1	25	Howell	1170	405TEFC	220/440
1	75	G.E.	1800	K-445S	440
1	100	West.	1160	CS	440
1	150	G.E.	720	KT-562	440
2	250	G.E.	1790	K-T.E.F.C.	2300
1	275	G.E.	1200	KT559BS	2200
2	300	G.E.	1800	K-4150V	new

MOTOR GENERATOR SETS

Qu	K.W.	Make	Speed	Volts DC	AC
1	30	G.E.	1800	125	220/440 V.
3	60	E.M.	1200	125	220 v. Syn.
1	75	G.E.	1800	250	580 v. S.C.
1	150	Cr. Wh.	600	125	220/440
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y S.R.
1	1000	West.	720	600	2300/4160Y

D.C. 230 VOLT MOTORS

Qu	HP	Make	Speed	Type
1	75	C.W.	900	WP
1	125	G.E.	1700	RC
2	150	C.W.	900	WP
1	250	Allis Ch.	1750	EBL149 BB

A.C. HOIST MOTORS

Qu	HP	Make	Type	Speed	Volts
1	35	G.E.	MTC	565	440
2	300	G.E.	ITC-5017	600	440

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POWER PLANT EQUIPMENT

SPECIAL OFFERINGS

TURBO-GENERATORS

1—1000 KW—240 volts—130/250# Condensing Auto. Extraction—15# New 1945

1—1000 KW 480 volts—225# Condensing Auto. Extraction—20#

1— 400 KW—550 volts—400# Condensing Auto. Extraction—20/50# New 1948

1— 300 KW—480 volts—210# Condensing Auto. Extraction—40#

1— 250 KW—240 volts—130#—Non-Cond. 10/12# Back pressure

TRANSFORMERS

1—500 KVA 4160/480 V. Pyranol. 3 ph.

3—500 KVA 2300/550 Volts (New 1948)

1—450 KVA—13,800/208 Volts—3 ph.—(network)

AIRFOIL F-D FANS, UNUSED.

2—50,000 CFM of air at 80° F against static pressure of 9.5" w.g.

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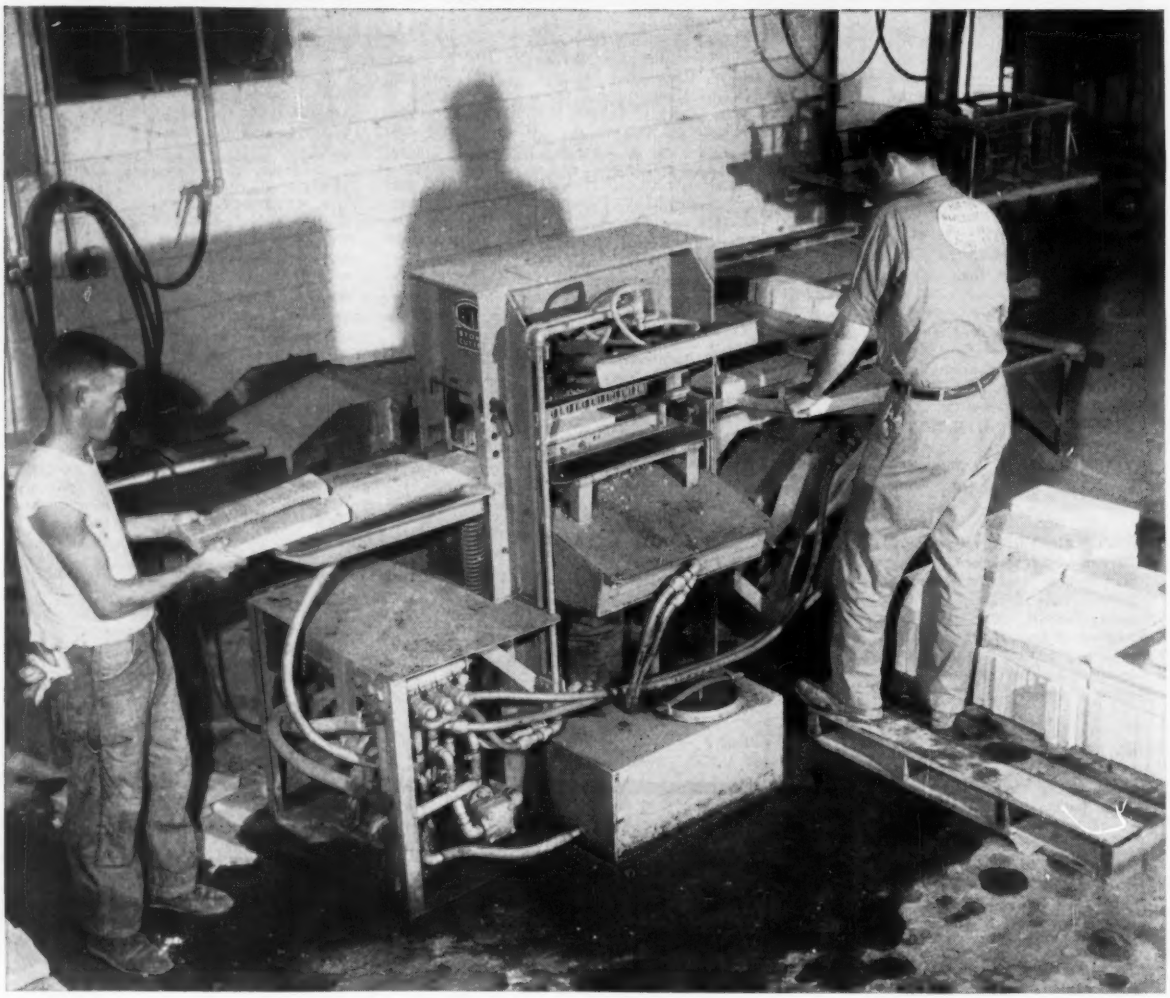

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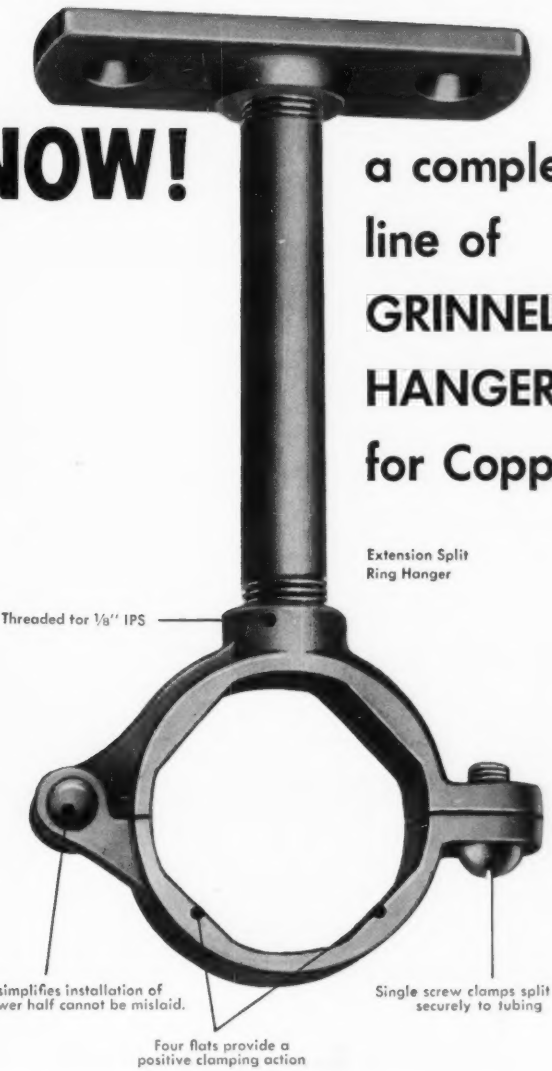
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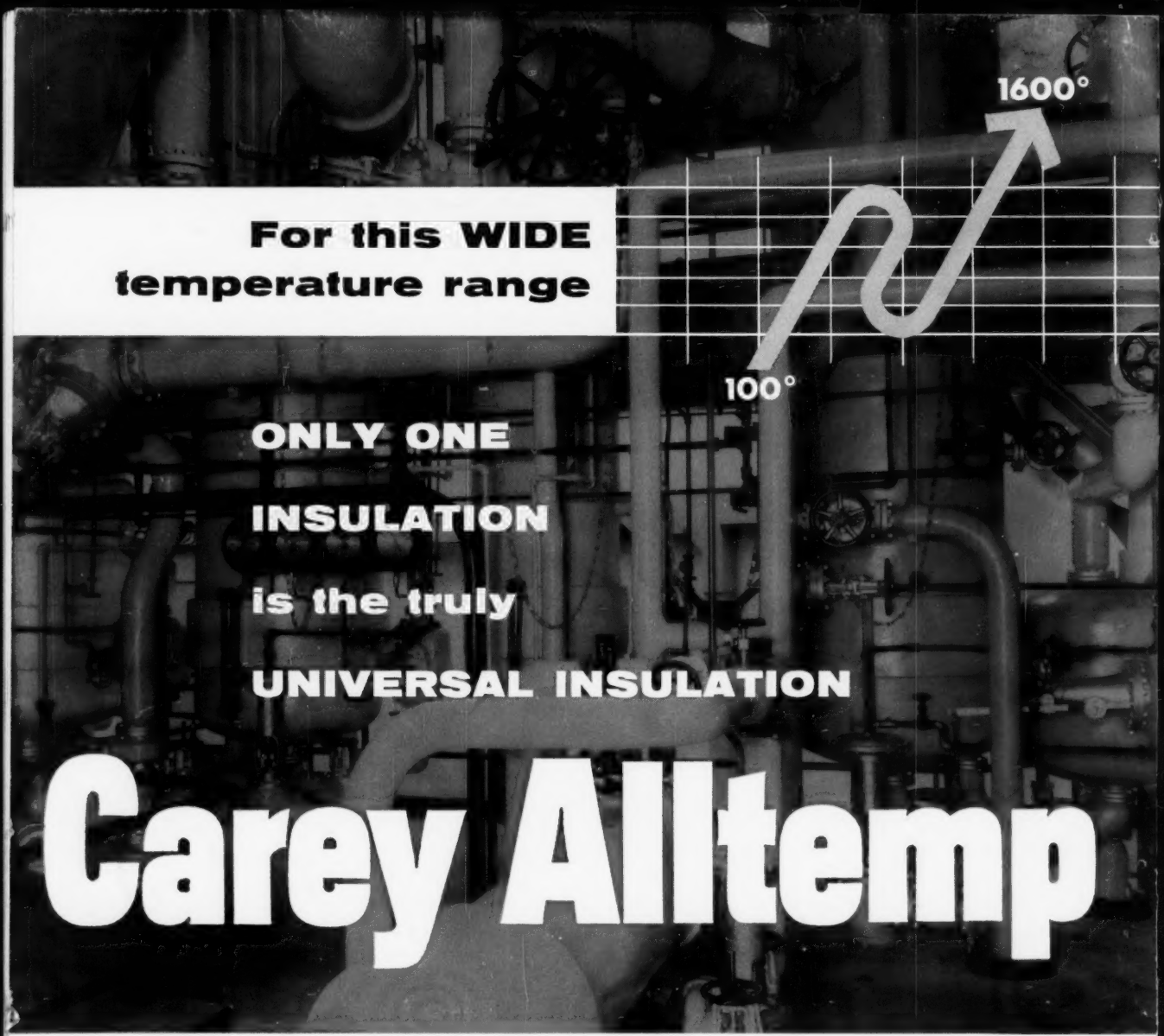

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